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Data Quality Objectives Summary Report for the 221-U Canyon Disposition Alternatives

HANFORD

Prepared for the U.S. Department of Energy
Office of Environmental Restoration

Bechtel Hanford, Inc.
Richland, Washington

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Environmental Excellence
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EXECUTIVE SUMMARY

The 221-U Canyon Disposition Alternatives Data Quality Objective (DQO) Process identifies the sampling and analytical requirements necessary to support future detailed evaluation of alternatives via the CERCLA process, for final disposition of the 221-U Canyon Facility. Viable alternatives for the disposition of the 221-U Facility have been identified in a CERCLA Phase I Feasibility Study (FS) (DOE-RL 1997) for the Canyon Disposition Initiative (CDI). The scope of this DQO Process is limited to the 221-U Process Canyon Building and equipment contained within the facility. Associated stacks, filters, solvent handling, vaults, and storage facilities external to the 221-U Building are not addressed in this DQO. This DQO focuses on the 221-U Building because it provides the greatest potential source of contaminant volumes and concentrations and the physical structure poses the greatest challenge for disposition decisions.

The 221-U Facility is one of three identical chemical separations plants simultaneously constructed at the Hanford Site in support of plutonium production. Called "canyon buildings" because of their monolithic size and the canyon-like appearance of their interiors, B Plant, T Plant, and the 221-U Facility were built to extract plutonium from fuel rods irradiated in the Hanford Site production reactors. Each separations plant was equipped to use a bismuth phosphate separation process. Because early operational experience indicated that B Plant and T Plants were sufficient to meet production goals, the 221-U Plant was never used to process plutonium. The 221-U Facility was used to train operators until 1952; between 1952 and 1958 the facility became the Uranium Recovery Plant. The facility was placed in standby in 1958. Figure 2-1 provides a cross-section of the 221-U Canyon Building.

Two key information inputs to the evaluation of the disposition alternatives are: (1) the structural integrity of the building itself and (2) the nature and extent of radionuclide and non-rad contamination within the structure. Structural integrity data will help to decide the viability of the entombment alternatives. Contaminant information is necessary to ensure the safety of workers, to evaluate contaminated equipment and building materials against disposal criteria, and to assess the potential for contaminant migration out of the facility to groundwater. The 221-U Canyon DQO Process develops a sampling and analytical strategy to: (1) characterize the structural integrity of the facility, and (2) determine the nature and distribution of the contaminants of potential concern (COPCs) within the facility.

The structural integrity will be assessed using a formal process, which consists of review of available documents, site inspections, and structural analysis followed by a formal assessment. The assessment will be used for the following purposes:

- to evaluate current capacities of the building structural systems safely to resist loadings during and after entombment operations, and

- to evaluate the flow paths in to and out of the canyon during and after entombment.

The information needed for performing this assessment is detailed in Tables 6-1 and 6-2. These tables outline the information needs, available information and its source, and information/data that must be collected.

Because the B and T Plants were built by the same organizations and to the same specifications as 221-U, much of the information previously used to evaluate primary structural systems and as-built strength of the materials from B Plant can be used in the assessment of 221-U. This information will be supplemented with facility-specific samples to characterize structural materials in the 221-U Building:

- Concrete member strength will be evaluated through collection of 12 cores from four sections in 221-U at elevations above the canyon working deck. Five-inch diameter cores are recommended.

- Twelve concrete cores from the ends of the building are recommended for strength testing and petrographic testing to assess the long-term effect of groundwater on the integrity of the concrete.

- Excavation of trenches in locations proximate to the coring locations or nondestructive examination methods are recommended to assess rebar locations for comparison to the drawings. Compressive strength testing of the cores and tensile testing of the rebar is recommended.

- Excavation is recommended at both ends of the 221-U Building to allow inspection of the process sewer.

This information, along with structural analysis of the load capacity of the soils below 221-U and the concrete members of the building, will be assessed in the structural evaluation report.

In addition to "process" equipment and piping that remain within the facility, an assortment of equipment from other Hanford Site facilities is stored in the 221-U Facility Canyon and cells. For this report, "process" equipment is any equipment that is physically connected to the 221-U Plant process system. The inventory records of equipment stored at 221-U from other facilities are incomplete. Therefore, all equipment not physically attached to 221-U is assumed to come from facilities other than 221-U and is called non-process equipment. Certain assumptions can be made regarding the COPCs for process equipment. Process knowledge allows characterization data from locations to be applied to similar process areas. Because the records for non-process equipment is less definitive, more extensive sampling is required to characterize this material.

The DQO provides a sampling strategy for the major 221-U functional areas, for both chemical and radiological COPCs. The strategy addresses process and non-process equipment, as well as building materials. Table 5-12 summarizes the approach for determining the volume of liquid remaining in the facility and the concentration of the potential contaminants. The final list of

COPCs and summary logic for selection or removal from the list are provided in Table S-1.
The sampling design is further divided by collection of concrete samples and residual material remaining in equipment using the following strategy.

- Existing radiological survey data will be supplemented with select samples collected for distribution of radionuclides to obtain isotopic distribution data for concrete.

- Radiological surveys of areas, such as the cells that have never been surveyed, will be done.

- The cells will be subdivided by function. To obtain information on the depth of penetration of the contaminants, cores of concrete representing each function will be obtained.

- Samples of liquid and sludge from process equipment will be examined from either the hot pipe trench or accessible equipment in the cells.

- Samples of liquid/sludge from non-process equipment will be collected preferentially from the equipment stored on the canyon deck. Equipment on the deck is more accessible and poses fewer as low as reasonably achievable (ALARA) concerns.

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CONTENTS

FIGURES

TABLES

APPENDICES

ACRONYMS

AIP	Agreement-in-Principle
ALARA	as low as reasonably achievable
CCTV	closed-circuit television
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminants of potential concern
curies/g U	curies per grams of uranium
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	data quality assessment
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
DST	double-shell tank
FFTF	Fast Flux Test Facility
FS	Feasibility Study
HAB	Hanford Advisory Board
Mw days/ton	megawatt days per ton
NDE	non-destructive examination
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PUREX	Plutonium Uranium Extraction
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction Oxidation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	sampling and analysis plan
SWP	special work permit
TBP	tributyl phosphate
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic
UO_3	uranium trioxide
VCR	video cassette recorder
WAC	Waste Acceptance Criteria
WESF	Waste Encapsulation and Storage Facility

1.0 SCOPE AND OBJECTIVES

1.1 SCOPE

The scope of the 221-U Canyon Disposition Alternatives Data Quality Objective (DQO) Process is to identify the sampling and analytical requirements to support the evaluation of alternatives for final disposition of the 221-U Canyon Facility. Alternatives range from removal and disposal of the building and all of its contents to a variety of entombment (i.e., leave-in-place) scenarios. The scope of this DQO Process is limited to the 221-U Process Canyon Building and the equipment within the facility. In addition to "process" equipment that remains within the facility from 221-U Facility process operations, there is an assortment of equipment from other Hanford Site facilities stored in the 221-U Facility Canyon and cells. For the purpose of this report, "process" equipment is any equipment that is physically connected to the 221-U Plant process system. The equipment inventory records stored at 221-U from other facilities are not complete. Therefore, all equipment not physically attached to 221-U is assumed to come from facilities other than 221-U.

U Plant refers to the 221-U Process Canyon Building and the Uranium Oxide Plant. External to the 221-U Building are associated stacks, filters, solvent handling, vaults, and storage facilities. This DQO focuses on the 221-U Building because it provides the greatest potential source of contaminants and the physical structure poses the greatest challenge for disposition decisions.

1.2 OBJECTIVES

Two key inputs to the evaluation of the disposition alternatives are: (1) the structural integrity of the building itself and (2) the nature and extent of radionuclide and non-rad contamination within the structure. Structural integrity data will help to determine the viability of the entombment alternatives. Contaminant information is necessary to evaluate protection of human health and the environment, under all scenarios, and to evaluate contaminated equipment and building materials against disposal criteria. The 221-U Canyon DQO Process develops a sampling and analytical strategy to: (1) characterize the structural integrity of the facility and (2) determine the nature and distribution of the contaminants of potential concern (COPCs) within the facility. The objective of the resultant sampling design is to provide adequate information to enable a quantitative evaluation of the disposition alternatives.

1.3 DATA QUALITY OBJECTIVES

The structural data generated as a result of the 221-U DQO Process must be adequate to support an engineering determination of the integrity of the facility for the various entombment alternatives described in the Feasibility Study (FS) (DOE-RL 1997). The information generated as a result of this DQO Process allows a determination of whether the facility can support the heavy equipment and fill materials projected under entombment alternatives.

The sampling and analysis data must provide a sufficient description of the nature and extent of contamination within the facility to evaluate the regulatory concerns associated with leaving materials in place, under the entombment alternatives, or removing and disposing of materials, under the removal alternatives. This data also should allow development of a program that will ensure protection of workers during implementation of any of the FS alternatives. The intent of this sampling and analysis is to collect representative samples from facility/equipment/solids and not to characterize individually each piece of equipment in detail.

2.0 FACILITY AND PROJECT BACKGROUND

2.1 PHYSICAL DESCRIPTION

The 221-U Facility is one of three identical chemical separations plants constructed at the Hanford Site in support of plutonium production. Called "canyon buildings" because of their monolithic size and the canyon-like appearance of their interiors, B Plant, T Plant, and the 221-U Facility were built to extract plutonium from fuel rods irradiated in the Hanford Site production reactors. However, no plutonium was processed in the 221-U Facility. The facility was used to recover uranium and then to store equipment from other canyons before being placed in the surveillance and maintenance program. Each separations plant was equipped to utilize a bismuth phosphate separation process. Because early operational experience indicated that B Plant and T Plant were sufficient to meet production goals, the 221-U Facility was held in reserve. A cross-section of the 221-U Canyon Building is illustrated in Figure 2-1.

2.1.1 221-U Facility Description Layout

The 221-U Facility is a multi-storied, predominantly reinforced concrete structure, approximately 247 m (810 ft) in length. Figure 2-2 is a simplified sketch of the building layout during uranium recovery mission.

The building had two major portions: the service portion, which housed personnel and equipment necessary for remote operation of the process portion, and the process portion, which contained the "hot" process equipment and the regulated work zones. The service portion of the building includes the Operating, Pipe, and Electrical Galleries. Other service areas are located adjacent to the 221-U Building in 271-U Building.

Regulated work zones are areas where personnel work with limited radiation exposure. The canyon deck level and the Canyon Crane Gallery were both classed as regulated work zones. The special work permit (SWP) (regulated work) change room, located at the northwest end of the operating gallery, was the central point used for entrance into the Canyon.

The Canyon cells housed the processing equipment for feed concentration and centrifugation, solvent-extraction, waste treatment, and solvent treatment. Piping connections between cells were made through the cell walls and the pipe trench. Because of the large volumes of solution necessary to process uranium at the instantaneous design rate (10 tons/day), two process lines were installed in the building (each capable of processing 5 tons of uranium/day) so that the smaller equipment sizes necessary to fit the Canyon cells could be used. Also, the installation of two process lines was desirable to give the Tributyl Phosphate (TBP) Plant (221-U) greater flexibility of operation and a greater range of feasible processing rates. The function of each Canyon section (a section contains two cells) is noted in Figure 2-2; cell functions are identified in Table 2-1, along with the currently available inventory of equipment within the cells and the cell volume. Stepped, removable 1.8-m (5.9-ft) thick concrete blocks cover and provide access to the cells.

The hot pipe trench runs parallel to the cells from Section 3 to Section 20 and is 2.4 m (7.87 ft) wide by 3.0 m (9.84 ft) deep. It contains intercell process piping and residual material transfer piping. Stepped, removable concrete blocks, similar to those over the cells, cover the hot pipe trench and provide access. Covers for the hot pipe trench are sized to match the adjacent cell, allowing uninterrupted access to contiguous work areas. The Ventilation Tunnel, 3.3 m (10.83 ft) high and 3.2 m (10.5 ft) wide, is directly beneath the hot pipe trench and provides exhaust ventilation for the cells and pipe trench.

Above the cells and hot pipe trench is 12.2 m (40 ft) of open space containing the overhead traveling bridge crane, equipped with 68-metric-ton and 9-metric-ton hoists. The final component of the canyon side is the railroad tunnel that enters at Section 2, Cell 3, and runs the width of the building.

2.1.2 Gallery Levels

The galleries are separated from the canyon by a 1.5-m (4.92-ft) to 2.7-m (8.86-ft) thick concrete wall. The four galleries, ordered from top to bottom, consist of the crane gallery, operating gallery, pipe gallery, and electrical gallery. The gallery side of the structure is 4.3 m (14.1 ft) wide.

The crane gallery, or cab way, is partitioned from the canyon by a 1.5-m (4.92-ft) thick wall, but it has no ceiling and is open to the process canyon. Located immediately beneath the crane gallery, the operating gallery allows complete remote operation of the process equipment through instrument and operating boards at each section. Under the operating gallery, all chemical, electrical, steam, and instrument lines enter the cells from the pipe gallery. Remote maintenance was not required in the electrical and pipe galleries; therefore, all fixtures are standard. On the lowest level, the electrical gallery contains all electrical and steam lines that enter the building and pass through the pipe gallery.

2.1.3 Design Features of the Canyon (221-U) Building

The design of the separations plant was based on five essential considerations:

1. adequate protection of operating personnel from radiation,
2. remote operation of process equipment,
3. remote maintenance of process equipment due to the presence of high radiation levels, and
4. flexibility of arrangement and layout so that a wide range of process steps could be undertaken without major redesign or rebuilding of the plant, and
5. Specific design features of faciliting components.

This last consideration was necessary because of the undeveloped state of the separation process when design was initiated on the project.

but relatively non-penetrating, beta and alpha radiation. Protection from all three sources of radiation can be obtained by a suitable combination of distance and shielding between personnel and the source of radiation. In the separations plant, shielding is obtained almost entirely by massive walls of concrete, which also serve as structural elements of the buildings themselves. Overall, the concrete shielding is heavy enough so that protection by distance is of secondary importance. Equipment placed behind the massive concrete walls, however, must be operated by remote control.

2.1.3.2 Remote Operation of Process Equipment. Recording and indicating instruments were used to follow temperature and density changes in process equipment, while motors and other moving parts were controlled electrically.

2.1.3.3 Remote Maintenance of Process Equipment. Remote maintenance of the separations plant was necessary, in most instances, due to the difficulty of decontaminating a piece of process equipment. In addition, it was essential that the process equipment contain no valves, pumps, stuffing boxes or other items that required periodic inspection and maintenance, or that during ordinary operation might leak or drip process solutions. This requirement was met by designing the process piping with single lines without T's or multiple connections, and designing the vessels to contain no bottom outlets. Pumps were eliminated by using steam-jet ejectors for all process transfers.

The process vessels themselves were designed to be removed or installed by a specially developed crane. The operator of this crane was protected in a heavily shielded cab and viewed the operations through a periscope. Piping connections were designed and could be made or broken by means of a remotely controlled, electrically operated impact wrench, which was carried on the crane. The piping itself was made up in standard prefabricated units that could be dropped into place by the crane. Special auto connectors were used to connect equipment/pipe.

2.1.3.4 Flexibility of Flow and Equipment Arrangement. When the design of the 221-U Facility began, the process itself was largely undeveloped. This required that the layout allow fundamental alterations in the equipment arrangement and process flow. In order to achieve this flexibility, the 221-U Building was designed, as far as possible, as a group of standard units in which different types of process vessels, pipe connections, and instrument hookups could be installed without requiring structural modification. The various equipment pieces were designed to permit installation at various locations in the standard units, as changing process requirements might dictate. Process piping entered each cell directly from the hot pipe trench. Cells are grouped by sections. Inter-cell connections are limited to cells within the same section.

2.1.3.5 Standard Cell. The standard cell is a 3.97 m by 5.19 m 20.32 cm (13 ft by 17 ft 8 in.) room that is 6.71 m (22 ft) high with 2.14-m (7-ft) thick concrete walls, and has a 1.83-m (6-ft) thick cover. The cover has removable sections and is the only means of access to the cell. The massive walls and cover shield personnel against radiation from process materials within the cell. The cover sections have stepped interlocking edges so that there are no straight cracks through which radiation can pass.

All pipe, instrument, sampling and control lines into the cell were buried in the concrete and terminate in connector flanges on the cell walls. These flanges were installed with a high degree of precision, and the cell walls and floor were finished accurately to standard dimensions so that the connector arrangement in the cells was fixed and uniform. Piping from a cell to the gallery is brought up in an S shape rather than straight through the concrete in order to minimize the escape of radiation from the cell.

Equipment was placed on the cell floor and held in position by guides built into the cell, thus establishing a standard relationship between the connector flanges on vessels and cell walls. This standard relationship made remote maintenance possible, because piping could be prefabricated to fit. Process transfer lines between cells in the section were run directly through the cell walls. Because of difficulties created by the expansion joint that separated adjacent sections, no piping runs through the walls between sections.

Cell 10 is the low point within the 221-U Canyon Building and contains tank 5-6. All cells and the hot pipe trench drain to this cell via a 60.97-cm (24-in.) concrete-encased tile sewer pipe; consequently, any leaks or spills would have drained into this cell.

2.1.3.6 Hot Pipe Trench. Process piping that carried active solution between sections was installed in a pipe trench that runs from Section 3 to Section 20 (hot pipe trench). Lines to and from the cells terminate in connector flanges in the trench. Just as in the cells, the connector flanges are held in fixed standard position by steel supports embedded in the concrete trench floor. The trench piping was in prefabricated sections attached to the flanges with automatic connectors. Between the piping and associated hardware, the hot pipe trench is extremely congested. The trench cover is in removable sections, similar to the cell covers. Alterations and replacements of trench piping could be made with the same remotely operated equipment used for cell maintenance.

Besides avoiding lines through expansion joints, the hot pipe trench served other purposes. It made process lines accessible for maintenance and contributed flexibility, since sections could be hooked up through the trench in different ways to conform to process changes.

2.1.3.7 Ventilation Tunnel. The 10 ft 6 in. by 10 ft by 7 in. concrete ventilation tunnel is located directly beneath the hot pipe trench. Air from the canyon deck flows through slots in the cell block covers to the cells and pipe trench, and then through 25.4-cm (10-in.) diameter terra cotta ducts from each cell and each section of the pipe trench to the ventilation tunnel. The tunnel exhausts into the 291-U exhaust stack. The tunnel was constructed with baffles spaced regularly along the floor to contain any condensate or other liquid that may have entered and to disrupt the air flow to minimize particulates entering the stack. The ventilation tunnel also drains any condensation to the concrete-encased tile sewer pipe, which drains into cell 10.

2.1.3.8 Operating Gallery. The operating gallery was the control center for cell equipment. At each section was a gauge board from which control and instrument lines ran to the cells, via the pipe gallery. Tanks used to weigh chemicals were provided with inlet connections from appropriate chemical headers in the pipe gallery and outlets to the cell vessel connections, also located in the pipe gallery.

2.1.3.9 Pipe Gallery. All cell piping, except process transfer lines, was brought up to the pipe gallery, terminating in connections on the wall. From here, connections were made to the weigh tanks and control boards in the operating gallery. Remote maintenance was not required; therefore, all connections were of the normal type. Chemical headers, electrical and steam distribution lines were also located in this gallery.

2.1.3.10 Electrical Gallery. The electrical, or basement gallery, contained principally electrical lines. The steam main also entered the building through this gallery.

2.1.4 Ventilation in 221-U Building

The 221-U Building contains two separate and distinct systems for ventilation. One system ventilates the process equipment areas, while the other ventilates the operating areas. Ten separate wet air washing units ventilate the process equipment areas, including the crane cabway and the cell deck area. This air exhausts to the ventilation tunnel (see Section 2.1.3.7).

Ventilation of the operating gallery is accomplished by ten air filtering and washing units distributed along the operating gallery proper; some air also flows from the 271-U Building into the operating gallery. Air from the operating gallery flows through gratings in the floor to the pipe gallery. Air is exhausted to the outside from the pipe gallery by nine exhaust fans and from the electrical gallery by three exhaust fans, one on each end of the gallery, and one in Section 1.

The air flow described above is always away from the operating areas toward the outside or into the process area.

2.2 PROCESS KNOWLEDGE

The separations plants were used to extract plutonium chemically, utilizing the bismuth phosphate process, from fuel irradiated in the 100-Area Reactors. Because the capacity and recovery efficiency of the separations process were better than estimates made based on small-scale experiments, only T and B Plants were needed. U Plant subsequently was used to train operators for T and B Plants until 1952, when it was converted to the TBP process to recover uranium from bismuth phosphate wastes. At that time, it became known as the Uranium Recovery Plant. The facility was placed in standby in 1958 and was subsequently retired.

2.2.1 Uranium Recovery Process

Each plant (Uranium Oxide Plant, Bismuth Phosphate Plant, and the TBP Plant) represents a step in the process. The function of the Uranium Recovery Plant was to produce a relatively pure uranium trioxide powder from the uranium irradiated in the Hanford piles (reactors) and processed, for plutonium recovery, through one of the Bismuth Phosphate Plants or the Reduction Oxidation (REDOX) Plant.

The uranium from the Bismuth Phosphate Plants was stored in single-shell tanks in the "Tank Farms" in the form of a uranium-bearing sludge and supernatant liquid. This material contained a large fraction of the radioactive fission products and traces of the plutonium formed in the pile-irradiation of the uranium. Facilities for removal of this uranium from underground storage constitute one of the three major components of the Uranium Recovery Plant.

The second major component of the Uranium Recovery Process is the TBP (221-U) Plant, where uranium is separated from fission products and residual plutonium by a solvent-extraction process.

The third major component of the Uranium Recovery Process is the Uranium Oxide Plant, where uranyl nitrate solutions produced by the TBP and REDOX Plants, meeting the required purity and radioactivity specifications, were converted to uranium trioxide (UO_3) powder by calcination.

2.2.1.1 Design Production Capacity and Yield. The uranium removal facilities and the TBP (221-U) Plant were designed to process the approximately 5,900 short tons of uranium in underground storage (as of January 1, 1952) at an average rate of 8 short tons/day. The maximum instantaneous design production capacity was 10 short tons of uranium/day. The removal facilities and the TBP Plant were designed to recover at least 95 percent of the uranium in underground storage. The estimated uranium loss in the TBP Plant, at a 10-ton/day instantaneous uranium processing rate, was approximately 1 percent. This loss represents uranium that did not separate out in solution.

2.2.1.2 Feed Material. The feed to the Uranium Recovery Plant consisted of uranium wastes from the Bismuth Phosphate Plants (B and T Plants) and the uranium product of the REDOX Plant. The Bismuth Phosphate Plants were used since the start-up of Hanford Works in 1944 to recover plutonium from uranium slugs irradiated in the Hanford piles. The uranium, accompanied by the bulk of the radioactive fission products, was discharged to tanks from the Bismuth Phosphate Plants in a slightly alkaline metastable waste solution (with a pH of approximately 10.5) described below. Table 2-2 lists the approximate proportions of the ingredients.

The metastable waste solution was stored in underground tanks at the Tank Farms, where solids—mainly complex sodium uranyl phosphocarbonates—separated and settled out, forming sludge. Approximately 75 percent of the uranium was contained in the sludge and the remaining 25 percent in the supernatant liquid. The feed to the Uranium Recovery Plant contained both the sludge and the supernate.

The fission-product radioactivity associated with the uranium was a function of the irradiation history of the parent slugs and of the time elapsed since irradiation. Table 2-3 lists the approximate ranges of radioactivities involved.

TBP Process. The TBP process utilized the preferential extractability of uranyl nitrate by TBP to separate uranium from the plutonium and fission products with which it was associated in the $BiPO_4$ process wastes.

The salts of uranium consist chiefly of two classes: (a) the uranous (U^{+4}), and (b) the uranyl (UO_2^{+2}). Uranium can exist in other valence states, but only the tetravalent and hexavalent forms are comparatively stable in aqueous solutions. U^{+4} is a strong reducing agent; it therefore follows that it is difficult to reduce UO_2^{+2} to U^{+4}. $UO_2(NO_3)_2$, the product of the dissolution of uranium in nitric acid, is very soluble in aqueous solutions and forms an organic-soluble complex with TBP ($UO_2[NO_3]_2 \cdot [TBP]_2$). When aqueous solutions are contacted with organic solutions of TBP (i.e., solutions of TBP in inert organic diluents), the uranium can be made to distribute preferentially into the organic phase by adding a salting agent (nitric acid or a nitrate salt) to the aqueous phase. Under these conditions, the plutonium, when reduced to the plus III valence state, and the fission products, still favors the aqueous phase. This preferential distribution, and the non-reducibility of UO_2^{+2} under conditions where plutonium is reduced to the plus III valence state, makes possible the separation of uranium from plutonium and the fission products in the TBP process.

Simplified Flowsheet. Figure 2-3 is a simplified flowsheet for the entire Uranium Recovery Plant. The path of uranium from the underground storage tanks and from REDOX to the final uranium product is shown across the top of the figure, and is labeled "Uranium Recover." The operations illustrated are conducted in three locations: in the removal facilities at the various $BiPO_4$ process tank farms, in the TBP Plant, and in the Uranium Oxide Plant. Also shown are the flow diagrams for auxiliary processing operations: HNO_3 recovery (Uranium Oxide Plant), solvent treatment (TBP Plant), and waste treatment (TBP Plant).

Figure 2-3 shows the code letters used to identify the process streams entering and leaving the TBP Plant solvent-extraction columns. For example, the three feed streams to the decontamination column (the RA Column) are the RAS (scrub) stream, the RAF (feed) stream, and the RAX (extractant) stream. The first letter, "R," identifies the uranium recovery process. The second letter, "A," "C," or "O," identifies the column (i.e., the RA [decontamination], RC [stripping], or RO [solvent recovery] column). The last letter identifies the stream. Influent stream abbreviations end in F, X, or S, which stand for feed, extractant, and scrub, respectively. Effluent streams end in U, W, or O, which stand for uranium, waste, and organic, respectively. Thus the RAF is the uranium-containing feed stream to the RA Column and the ROO is the purified organic effluent for the RO Column.

2.2.1.4 Layaway Operation. The processing of all available recovered uranium was completed in the TBP Plant during March of 1957, and layaway of the Plant was started. Flushing of the process vessels was completed on April 12, 1957; a total of 173 kg (381 lb) of uranium was recovered and was unaccounted for in the material accountability system. The loss could be attributed to measurement error and losses to the residual material in pipes. If one wants to be conservative, one can assume all the material remains in the facility. All dry chemicals have been removed from the building. Acid and caustic solution left over in the 211 storage tanks was left for use by the Waste Handling and Decontamination Operation. Canyon cells from 19 through 40 have been inventoried and steam cleaned. Cells 1 through 18 were not inventoried or steam cleaned.

Maintenance work of flushing, draining and capping process, steam, water and air lines was approximately 50 percent complete as of April 1957. Instrument and electrical layaway was

65 percent complete as of April 1957. Work remaining to be completed, as of April 1957, included decontamination of cover blocks and disposal of trash.

Since the shutdown of U Plant, the canyon has been used to store deactivated equipment. Table 2-1 details the function, equipment (both 221-U process and equipment imported from other) contained, and volume of each cell.

2.2.1.5 Miscellaneous Equipment. Since its shutdown, the U-Plant canyon has been used to store deactivated equipment from other plants. After the final placement of the cell cover blocks, any deactivated equipment received was stored on the canyon deck. Although no volume estimates could be generated, a listing of the equipment on the canyon deck is contained in Appendix A, along with the available sources of information for the equipment. Approximately 85 m^3 (3,002 yd^3) of equipment is on the walkway from Section 3 to Section 20.

2.2.2 Inactive Facility Surveillance and Maintenance

The 221-U Facility was placed in standby in 1958, and was subsequently retired. All TBP process hardware supposedly remains in place. The canyon building is currently used for storage of spare equipment that had been reconditioned in the T-Plant equipment decontamination facility. Decontamination and reclamation activity was also accomplished at the 221-U Facility for an unspecified period. The overhead crane can be made operable. Electrical power, sanitary and raw water, and steam are available. The deck level of the canyon has been decontaminated to a level that allows reasonable access with a low level of radiation exposure. The electrical gallery is contaminated in spots (see DQO Scoping Binder [Rugg 1997]). Radiological conditions in the Railroad Tunnel have not been characterized; conditions in the process areas below the canyon deck (i.e., cells, ventilation tunnel, and hot pipe trench) are considered prohibitive for personnel access. One building air supply fan and one exhaust fan continue to operate; the exhaust fan exhausts through the 291-U sand filter.

2.3 PLAN FOR PROJECT ACTION

2.3.1 Canyon Disposition Initiative

In 1996, a Canyon Task Team of personnel from the U.S. Department of Energy, Richland Operations Office (DOE-RL), U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology), conducted a series of workshops to identify an approach for the long-term disposition of the five main processing facilities in the 200 Area (B Plant, T Plant, and 221-U Facility; Plutonium Uranium Extraction Facility [PUREX]; and REDOX Plant) at the Hanford Site. The assessment made by the Canyon Task Team centered on the possibilities of removing the processing facilities, leaving all or part of the facilities in situ, and identifying alternative beneficial uses for the facilities. The team concluded that the technical approach for dispositioning any of the facilities could be bounded by six basic alternatives:

1. Full Removal and Disposal
2. Decontaminate and Leave in Place
3. Entombment with Internal Waste Disposal
4. Entombment with Internal/External Waste Disposal
5. Close in Place - Standing Structure (clean fill)
6. Close in Place - Collapsed Structure.

The team decided to use the 221-U Facility as the "test canyon" for the disposition evaluation for the following reasons.

1. The crane is operational, allowing movement of equipment.

2. The facility is not a treatment, storage, and disposal facility.

3. Because the facility was not used for plutonium processing, it is less contaminated than the other canyons, and there is less chance of having transuranic (TRU) waste.

4. The facility is not currently operational; therefore, there is less disturbance of Hanford Site infrastructure.

The team also concluded that the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) regulatory process would be the appropriate decision-making pathway at this time.

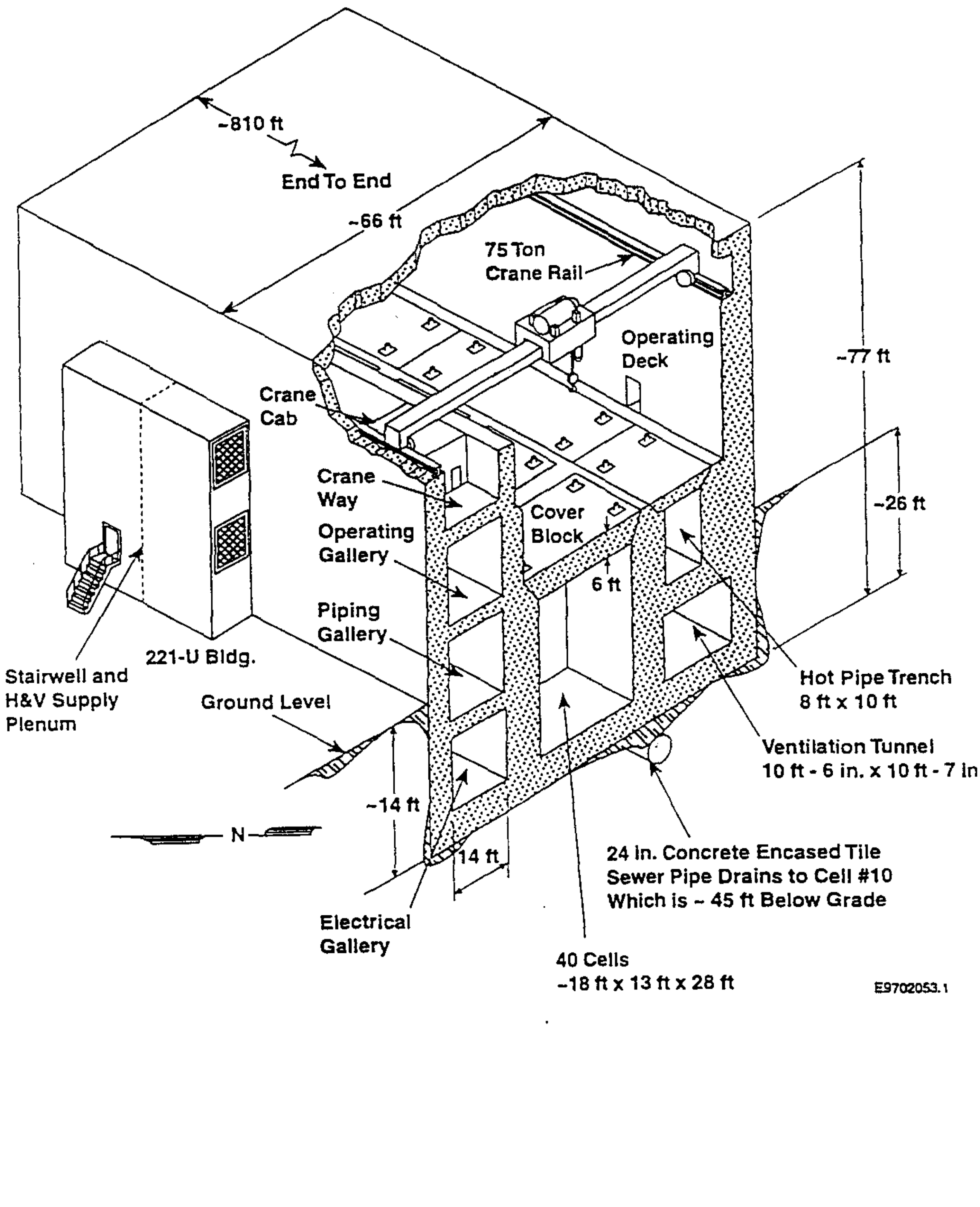
2.3.2 Feasibility Study

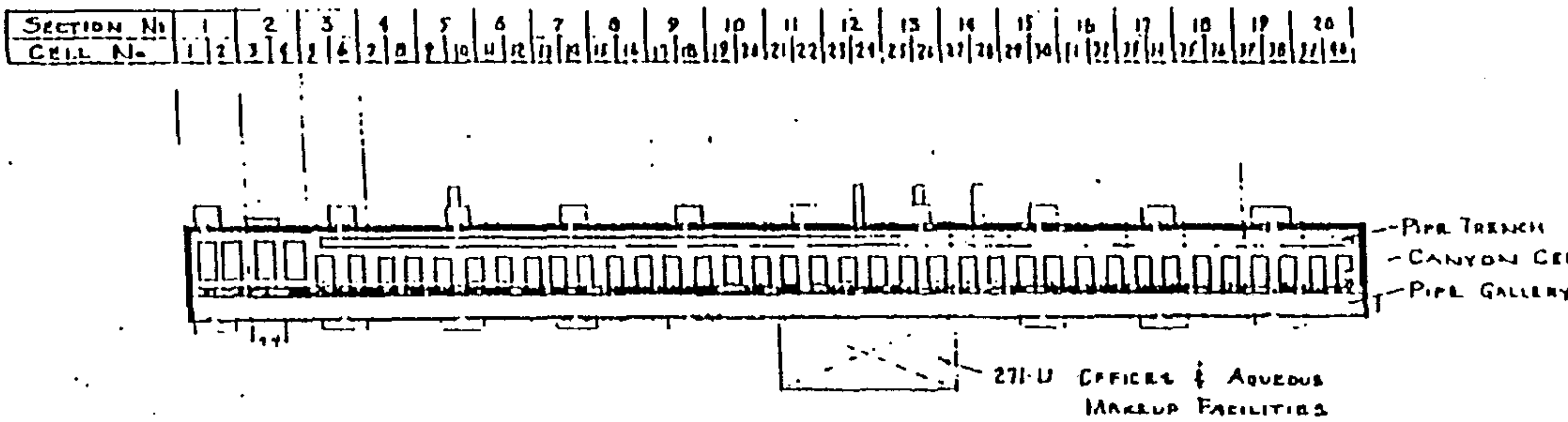
Because of the Canyon Task Team work, an Agreement-in-Principle (AIP) was signed by DOE-RL, EPA, and Ecology (Tri-Parties). The AIP documented the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) parties' support to initiate a Phase I Feasibility Study. Upon completion of the Phase I screening step, a decision will be made by the Tri-Parties on whether to continue with the remaining characterization and completion of the Remedial Investigation/Feasibility Study (RI/FS) process to reach a Record of Decision (ROD).

2.4 EXISTING SOURCES OF DATA

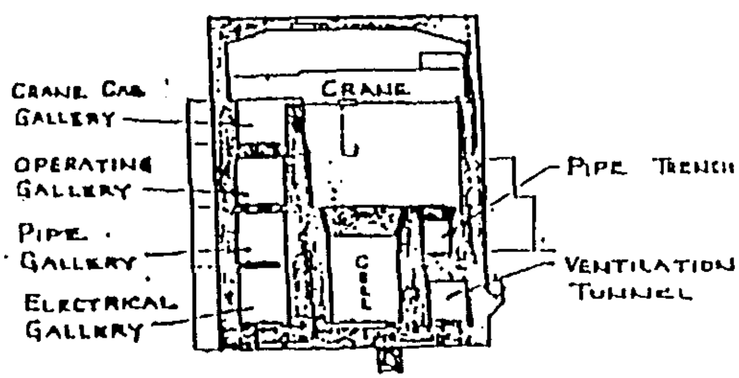
The *Phase I Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE-RL 1997) contains general background information for the Canyon facility and the disposition alternatives. The references cited in that document are an initial starting point for information to support this DQO. Additional data is being collected to provide more detailed information on processes that took place in the facility, structural information for the building itself, and equipment from other on-site operations stored in the facility. Record review activity commenced on April 14, 1997. An initial report of available information was completed in draft form on May 20, 1997. Records review and historical assessment is an ongoing evolution throughout the project. A complete listing of documents used in scoping the DQO is found in *DQO Scoping Checklist/Binder for the Characterization of the 221-U Facility* (Rugg 1997).

Figure 2-1. Cross-Section of the 221-U Canyon Building





PLAN AT SECOND FLOOR



CANYON CROSS SECTION

SECTION FUNCTIONS

1. EMPTY
2. R.R TUNNEL
3. FEED RECEIVING
4. FEED & WASTE HOLDUP
5. SUMP SOLUTION HOLDUP
6. FEED EVAPORATION
7. FEED EVAPORATION
8. EVAPORATION (SPARE)
9. WASTE EVAPORATION
10. WASTE EVAPORATION
11. WASTE NEUTRALIZATION
12. WASTE SAMPLING
13. WASTE RECEIVING
14. FEED CENTRIFUGATION
15. URANIUM SAMPLING
16. URANIUM RECEIVING
17. SOLVENT EXTRACTION
18. SOLVENT TREATMENT
19. SOLVENT EXTRACTION
20. SOLVENT TREATMENT

Figure 2-2. Simplified TBP Plant (221-U Building) Layout

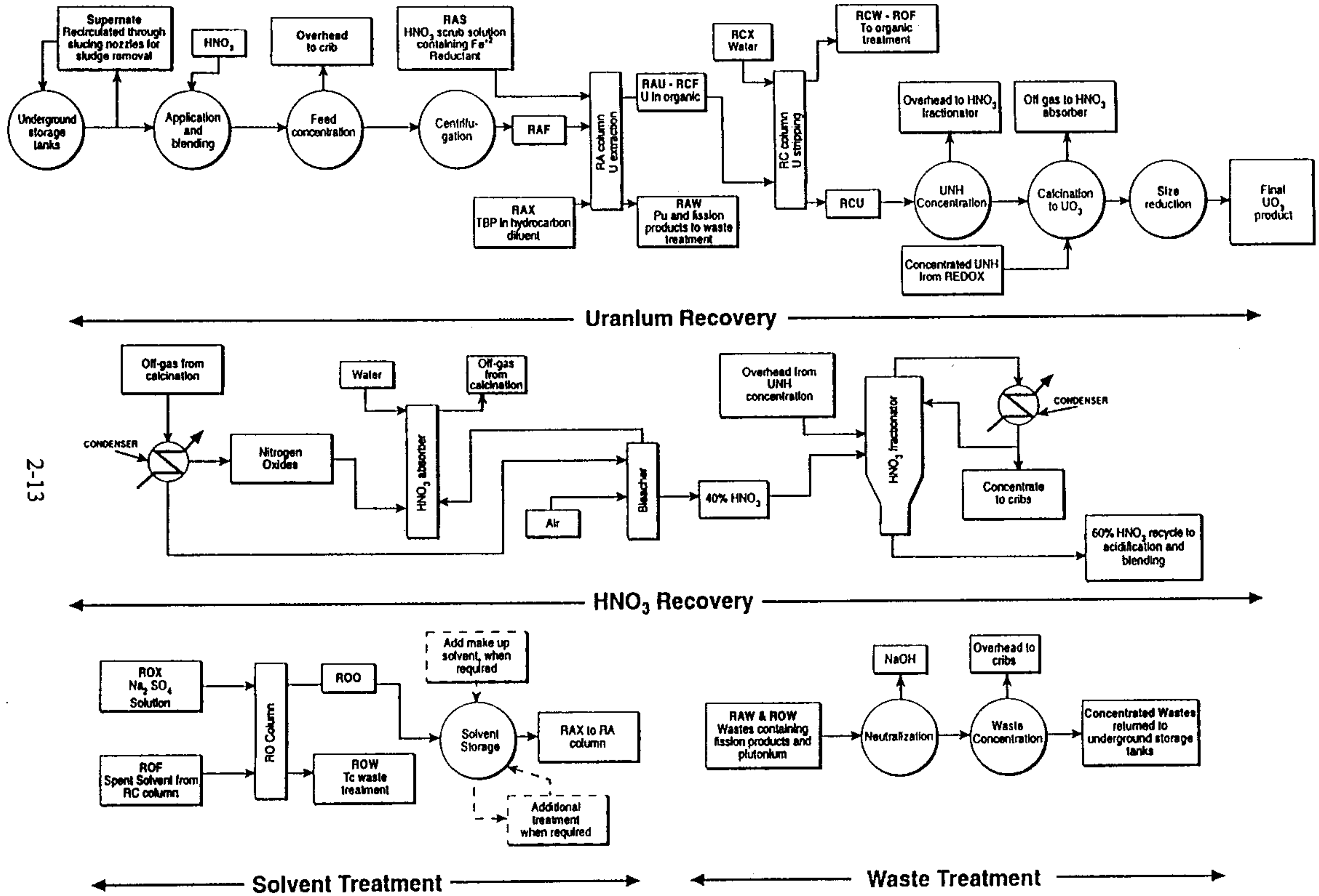


Figure 2-3. U Plant Aggregate Area Major Processes

Table 2-1. U Plant Canyon Cell Functions, Equipment, and Volumes (Page 1 of 3)

Cell	Function	Equipment	Cell Volume (m^3)
1	Storage	Empty	143
2	Storage	REDOX vessels D-13, G-13 tank, G-3 concentrator, H-4 coil	143
3	Access to railroad tunnel	Unknown	640
4	Storage	Fuel storage rack (0.4 x 3.0 x 4.3)	555
5	Storage	B Plant centrifuges (3) Pair of fuel canisters (19)	143
6	Feed receiving	U Plant tank (2.7 x 2.7)	143
7	Storage	PUREX Equipment: Pumps (3) B Plant Equipment: Pumps (2) Agitators (4)	143
8	Cell drainage	Tank 4-6	143
9	Cell drainage	Tanks 5-1 and 5-2	143
10	Cell drainage	Active residual material handling tank 5-6	312
11	Evaporation and concentration	Evaporator dunnage from U Plant U Plant tank 6-4 B Plant F-22 filter	143
12	Storage	PUREX pot dissolver B Plant centrifuge	143
13	Evaporation and concentration	Evaporator Concentrator cooler Feed stripping tower Concentrator seal pot Concentrator condenser	143
14	Storage, residual material concentration	Agitators (6) Pumps (8) U Plant tank	143
15	Evaporation and concentration	Evaporator Concentrator cooler Feed stripping tower Concentrator seal pot Concentrator condenser	143
16	Storage, residual material concentration	B Plant tank PUREX thorium jumpers (17) Concentrator feed receiver	143

Table 2-1. U Plant Canyon Cell Functions, Equipment, and Volumes (Page 2 of 3)

Cell	Function	Equipment	Cell Volume (m^3)
17	Evaporation and concentration	Evaporator Concentrator cooler Concentration tower Concentrator seal pot Concentrator condenser	143
18	Storage	PUREX F-8 tank	143
19	Evaporation and concentration	Evaporator Concentrator cooler Concentration tower Concentrator seal pot Concentrator condenser	143
20	Residual material concentration	Concentrator for feed tank Concentrator feed receiver	143
21	Residual material sampling	Sampler tank	143
22	Residual material neutralization	Neutralizer tank	143
23	Residual material sampling	Residual material sampler tank	143
24	Residual material sampling	U Plant tank (2.4 x 4.3) U Plant pump PUREX crane toolbox	143
25	Residual material sampling	Residual material sampler tank	143
26	Aqueous effluent, spent solvent stream receiving	Receiver tank	143
27	Feed preparation	Centrifuge catch tank	143
28	Feed preparation	Centrifuge catch tank	143
29	Storage	B Plant ti-tube bundles (2)	143
30	Storage	REDOX pots (2) REDOX towers (2)	143
31	Storage	B Plant centrifuges REDOX tube bundles (2)	143
32	Aqueous effluent receiving	Tank (2.7 x 2.7)	143
33	Spent solvent stream receiving, stripping and aqueous effluent processing	Spent solvent stream receiver tank Stripping column Aqueous effluent pump-out tank	143
34	Residual material receiving and treatment	Uranium-containing stream feed tank Aqueous effluent receiver tank Decontamination column	143

Table 2-1. U Plant Canyon Cell Functions, Equipment, and Volumes (Page 3 of 3)

Cell	Function	Equipment	Cell Volume (m^3)
35	Residual material receiving and treatment	RIOW receiver tank RIO column RIOO receiver tanks	143
36	Hydrocarbon diluent feed	U Plant tank (2.1 x 4.3)	143
37	Spent solvent stream receiving, stripping, and aqueous effluent processing	Stripping column Pump-out and receiving tanks	143
38	Residual material receiving and treatment	Uranium-containing stream feed tank Decontamination column Aqueous effluent receiver tank	143
39	RIIOO and RIIOW receiving, RIIO processing	RIIOO receiver tank RIOO column RIIOW receiver tank	143
40	Feed receiving	Hydrocarbon diluent feed tank	143

Source: DQO Scoping Document (Rugg 1997).

Table 2-2. Bismuth Phosphate Plant Output

Constituent	lb/Short Ton U
UNH - Uranyl Nitrate	4,220
HNO_3 - Nitric Acid	170 to 210
H_2SO_4 - Sulfuric Acid	700 to 810
H_3PO_4 - Phosphoric Acid	730 to 1,110
$NaNO_3$ - Sodium Nitrate	130 to 210
NaOH - Sodium Hydroxide	1,560 to 1,680
Na_2CO_3 - Sodium Carbonate	3,960 to 4,060
H_2O - Water	about 27,000 to 28,000

NOTE: The volume associated with 1 ton of uranium was approximately 15,200 L (4,000 gal).

Table 2-3. Fission Products Associated with U-Plant Feed

Age (Years)	Irradiation Level, Mw Days/Ton	Fission-Product Radioactivity, (Theoretical) Curies/g U		Remarks
		Beta	Gamma	
7	200	$2.8x10^{-3}$	$6x10^{-4}$	Oldest, least radioactive residual material available.
2	200	$1.1x10^{-2}$	$3.9x10^{-3}$	This is approximately the most highly radioactive feed that can be successfully decontaminated from fission products in the TBP Plant to meet specifications for recovered uranium.
2	400	$1.9x10^{-2}$	$6.5x10^{-3}$	

NOTE: The plutonium content of the uranium residual was about 2 to 4 g/ton of uranium.

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3.0 PARTICIPANTS AND RESPONSIBILITIES

The 221-U Canyon Disposition Team participants, their roles, and respective organizations are listed in Table 3-1.

The Global Issues meeting was held on June 10, 1997. External DQO meetings were held June 16, 18, 26, and July 17 and 21, 1997. The meeting minutes are in Appendix B.

Table 3-1. 221-U Canyon Disposition Team

Participants			1997 Meeting Dates				
Name	**Role**	**Organization**	**6/16**	**6/18**	**6/26**	**7/17**	**7/21**
J. Baxter	Structural Engineer	FDNW			X	X	X
R. R. Borisch	Eng. Support	BWHC	X	X			
T. M. Brown	Data Support	CHI	X	X	X	X	X
D. Carlson	Statistician	EQM/Neptune	X	X	X	X	
G. Cox	Eng. Support	BWHC	X	X		X	X
J. W. Donnelly	Project Manager	Ecology	X	X	X	X	
D. B. Encke	Data Support	CHI	X	X	X	X	X
J. Goodenough	D&D Senior Project Manager	DOE-RL	X	X			
R.P. Henckel	Task Lead	BHI	X	X	X	X	X
P. S. Innis	Project Manager	EPA	X	X	X	X	X
K. Jackson	Sampling Specialist	BHI			X		
M. S. Miller	Facilitator	EQM	X	X	X	X	X
S. Mohan	U-Plant Project Manager	Ecology				X	
L. E. Oates	Co-Facilitator	EQM	X	X	X	X	X
A. Robinson	Radiological Support	EQM		X	X	X	
J. E. Rugg	Env. Lead/ Technical Lead	BHI		X	X	X	X
J. P. Sands	D&D Project Manager	DOE-RL			X	X	X
W. Thompson	Sampling Support	BHI			X		
R. Weiss	Analytical Support	CHI			X	X	X
R. Winslow	Radiological Engineer	THI			X		

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4.0 PREPARATION (BASELINE ACTIVITIES)

4.1 SCOPING/DATA QUALITY OBJECTIVE CHECKLIST

A project start-up meeting was held Wednesday, May 14, 1997. Present were the DQO Project Manager, Environmental Lead/Project Engineer, and the co-facilitator. During this meeting, an overview of the project was discussed, and also schedule concerns. The high visibility of the project was emphasized along with the potential implications for overall site remediation activities. Coordination with a proposed technology demonstration to be applied to the facility is a consideration for the DQO Process.

The Environmental Lead/Project Engineer prepared a DQO Scoping Binder (Rugg 1997). In addition, as noted in Section 2.4, historical data has been compiled in a summary report that was distributed to participants in the Global Issues and DQO Meetings.

4.2 SCOPING PROCESS ISSUES

The 221-U Canyon Project, due in part to the innovative alternatives that are being evaluated through the FS, has attained high visibility before the start up of the DQO Process. This visibility has generated a variety of issues and concerns, some of which will provide bounds on the process; others require consideration during and will feed into the DQO Process. Some of these issues are addressed in the DQO Scoping Binder (Rugg 1997); they are repeated here due to their significance in determining project scope and direction. The more significant issues raised before the initiation of the formal DQO are identified below.

- Will the 221-U Canyon Disposition Alternatives DQO Process address issues associated with the 221-U Facility structure only? The original focus of the project was the identification of contamination concerns that have the potential to affect worker health and safety and/or groundwater quality. Subsequent discussions focused on data needed to support removal/disposal, risk assessment, worker health and safety, parameters affecting entombment, and structural integrity. Other contaminated areas surrounding the facility, such as the WR Vault and cross-site transfer lines, will not be addressed in this DQO Process. The other contaminated areas were not included because their contribution to the source term concentration is less than the 221-U Facility. The DQO will address information needs for assessment of the disposition alternatives focusing on the 221-U Facility alone.

- The EPA, Ecology, and DOE have signed an AIP, which states that the final disposition of the 221-U Canyon Facility will be determined through the CERCLA remedial action process. The process will consist of a Phase I FS, Sampling and Analysis Plan (SAP), Phase II FS, Proposed Plan, ROD, and Remedial Design/Remedial Action Work Plan. This DQO supports a sampling plan to provide data to refine evaluation of alternatives and support a Phase II FS.

- The Hanford Advisory Board (HAB) has reviewed the Phase I FS. The HAB developed a list of issues; many of these are policy or operational issues that cannot be addressed by this DQO Process. Some HAB issues that are relevant to the DQO include concerns over structural integrity, a need for secondary containment, the role of U.S. Nuclear Regulatory Commission (NRC) regulations and guidance, waste forms, and risk to workers (see *Draft Framing of Issues on Disposition of Canyon Facilities*, Revision 1, prepared for the Health, Safety, and Waste Management and Environmental Restoration Committee, March 7, 1997).

4.3 INTERVIEW PROCESS ISSUES

The DQO co-facilitator conducted interviews with the primary decision makers and other project team members during May 22 to June 5, 1997. Major issues that are relevant to this DQO Process and identified during these interviews are identified below.

- Is the DQO Process to address only material characterization from a *Resource Conservation and Recovery Act of 1976* (RCRA)/CERCLA perspective, or is it to include structural data as well?
- Does the project scope encompass the wastes that could be emplaced in the facility or just the facility?
- Is characterization to address all aspects of operations (i.e., baseline characterization, closure of the facility, and long-term monitoring)?
- What are the decision units for characterization of radionuclide inventories (e.g., cells, sections, canyon)?
- Issues to be resolved include as low as reasonably achievable (ALARA) concerns both for sampling and implementation of alternatives, analysis of materials within the facility, which materials are suitable for land disposal, and the inventory of TRU material.
- What is the availability and reliability of historical data?
- Can one or more alternatives from the FS be eliminated?
- The DQO should establish COPCs, areas of concern, and sampling strategies.
- Do entombment alternatives require a RCRA liner and leachate collection system for the facility? If yes, does the facility provide equivalent protection?
- Which of the materials present in the facility are appropriate for entombment?
- The primary role of the DQO is to determine what sampling is necessary.

- During the initial stages of the 221-U Canyon project, CERCLA is the primary regulatory driver. The primary regulation guiding certain aspects of project activities may become RCRA if entombment with waste disposal is selected as the preferred alternative.

4.4 GLOBAL ISSUES

A Global Issues meeting was held Tuesday, June 10, 1997, to identify the major issues that are to be addressed and establish a structure for this DQO Process. The participants developed a listing of significant issues, grouped according to those that require data for resolution and those that do not; this list is provided in Table 4-1. The meeting minutes are provided in Appendix B.

As a part of the process, the attendees were charged with developing their own list of problems and decisions that effect data collection. These decisions are to provide a basis for the subsequent steps in the DQO Process—developing a problem statement, identifying inputs and limits for decisions, and creating decision logic.

After developing the issues and establishing the structure for the DQO Process, an overview of the background materials gathered to date was provided.

Table 4-1. Global Issues for the 221-U DQO Process (Page 1 of 2)

Issues That Require Data for Resolution	Issues That Do Not Require Data for Resolution
Structural integrity of building to handle waste	Protection of groundwater - what model to use?
Leach rate through the facility and soil	Barrier design
Types of residual material present in facility	Types of waste facility can accept
Regulatory equivalence of liner versus cement	Geographic boundary for DQO (facility, canyon; complex versus building)
Identification of COPCs (facility and surrounding sites)	Source of material for barrier
Source of material for backfill	Source of material for backfill
Size of allowable hotspots	Identification of compliance with ARARs
TRU determination	Waste volume definitions (what is package size?)
Preliminary remediation goals (PRGs)	Detection limits (for PRGs)
Infrastructure support	NRC role
Exterior facilities	Retrievable storage versus Permanent storage
Health and safety	Regulatory equivalency
Location of underground voids	Allowable voids
Residual material identification	Method to arrive at alternatives

Table 4-1. Global Issues for the 221-U DQO Process (Page 2 of 2)

Issues That Require Data for Resolution	Issues That Do Not Require Data for Resolution
Backfill source	Future land use
Monitoring (baseline)	NRC regulatory guidance
Airborne control	Impacts of Hanford 10-year plan on viability of alternatives
Regulatory pathway for entombment	Intruder protection/institutional control
Performance assessment	Boundary erosion
Waste projections (external)	Accessibility for waste disposal
Load-bearing capacity of soils	Mobile metal melter
Seismic loading	
Criteria; if used for waste disposal	
Condition and description of under canyon drain	
Residual material identification	

5.0 DATA QUALITY OBJECTIVES PROCESS-CHEMICAL/RADIOLOGICAL SAMPLING STRATEGY

The DQO Process for the 221-U Canyon Disposition Alternatives was performed according to BHI-EE-01, Environmental Investigations Procedures, EIP. 1.2, "Data Quality Objectives," Rev. 2. The DQO Process examines why data is needed, the decisions the data will support, and the sampling design required. In order to make the decisions related to the disposition of the facility, two types of data/information are required:

- chemical/radiological data
- structural.

The decisions and approach for collection of these two types of data differ significantly and are discussed in separate sections of this document. Section 5.0 provides the output from the DQO Process for collection of chemical and radiological data. Section 6.0 provides the output from each step of the DQO Process for collection of structural information and data.

5.1 DATA QUALITY OBJECTIVE STEP 1: PROBLEM STATEMENT

5.1.1 Summary of Background

The 221-U (U Plant) Canyon Facility was used for recovery of uranium from the by-products of plutonium production processing. Operations at the facility were terminated in the late 1950s and records show that flushing of process, steam, water, and air lines was 50 percent complete in 1957. Besides radionuclide contamination, process chemicals, acids, and caustic solutions may remain in the facility. Since the facility was shut down, equipment from the other Hanford processing facilities has been stored within the canyon. Although some equipment may have been decontaminated, the residual radiation and process chemicals inventory for the equipment has not been established.

The options for disposition of the facility are listed in Section 2.3.1 of this report and are fully discussed in the Phase I FS report (DOE-RL 1997). The six options are bounded by variations of two basic alternatives:

- full removal and disposal of the building and equipment
- entombment.

The following information is known:

- process knowledge per Section 2.2,
- types of equipment used in 221-U (Table 2-1),
- partial inventories of equipment stored from other facilities in the gallery and cells, and
- radiological survey and swipe data from the concrete per Appendix A.

5.1.2 Problem Statement

The volume and concentrations of chemicals and radionuclides are not well defined but are needed to allow evaluation of the three bounding cases for facility disposition.

Health and safety is a priority during disposition activities. The impacts to personnel cannot be calculated without the characterization information in the previous statement. Any removal/disposal, entombment, or leave-in-place alternative requires an estimate of the information in the problem statement for purposes of meeting regulatory criteria for the disposal options and risk evaluation.

5.2 DATA QUALITY OBJECTIVE STEP 2: DECISION STATEMENT(S)

The purpose of this step is to identify the key decisions that will be made. Draft decision statements were presented in the meetings of June 16 and 18, 1997 (Appendix B). Decisions related to chemical/radiological characterization data needs are summarized in this section.

5.2.1 Principal Study Question

What are the concentrations of the radiological and chemical contaminants present in the 221-U Facility?

5.2.1.1 Alternative Actions.

- Current knowledge provides an adequate definition of the nature and distribution of contaminants present in the canyon, cells, and other parts of the facility to allow an evaluation of regulatory, health and safety, and compatibility concerns. No additional sampling is required to support characterization.

- Existing information does not provide sufficient basis to decide regulatory, health and safety, and/or compatibility issues; additional sampling is required.

- Existing information provides sufficient basis for some, but not all of the data needs for the various alternatives; additional sampling is required.

5.2.1.2 Decision Statement. Determine the nature and extent of radiological and non-rad contamination present in the 221-U Facility with sufficient detail to support regulatory, health and safety, and compatibility decisions for the entombment and removal alternatives.

5.2.2 Secondary Study Questions

5.2.2.1 Does existing material/equipment designate as TRU material?

5.2.2.1.1 Alternative Actions.

- Segregate and remove material that is TRU and dispose in a facility permitted to accept TRU waste. Full entombment remains an alternative.
- Too much TRU material exists to remove to allow full entombment to be an option. Assess alternatives as appropriate.

5.2.2.1.2 Decision Statement. Determine whether equipment/material designates as TRU.

5.2.2.2 Does existing material or process equipment exceed Class C criteria?

5.2.2.2.1 Alternative Actions.

- Segregate and remove material that is greater than Class C for special safety analysis and disposal handling criteria and dispose in a facility allowed to accept greater than Class C waste. Full entombment remains an alternative. Assess alternatives as appropriate.
- Too much greater than Class C material exists to remove to allow full entombment to be an option. The removal disposition alternative is selected.

5.2.2.2.2 Decision Statement. Determine whether equipment/material contains greater than Class C contamination levels to assess alternatives.

5.2.2.3 Does material/equipment contain leachable non-radioactive constituents listed in Table 5-11?

5.2.2.3.1 Alternative Actions.

- Segregate and either treat or remove constituents as appropriate before entombment. Entombment remains an alternative.
- Sufficient unremovable, leachable, non-radiological constituents (see Table 5-11) are identified in the facility, which preclude entombment. The removal option is selected.

5.2.2.3.2 Decision Statement. Determine whether equipment/material contains leachable non-radioactive contaminants, as listed in Table 5-11, and assess alternatives.

5.2.2.4 Does the conceptual model indicate that the groundwater will be protected?

5.2.2.4.1 Alternative Actions.

- Fate and transport and risk models indicate that groundwater will be protected. Full entombment remains an alternative.

- Fate and transport and risk models indicate that groundwater will not be protected. Assess alternatives as appropriate.

5.2.2.4.2 Decision Statement. Determine whether contaminants exceed groundwater protection criteria to assess alternatives.

5.3 DATA QUALITY OBJECTIVE STEP 3: INPUTS

Table 5-1 provides a list of the inputs that will be required to support the 221-U Facility disposition alternatives. Inputs in Table 5-1 are listed by the boundaries discussed below. The original COPCs listed in this table are based on the FS (DOE-RL 1997). Additional evaluation of COPCs has resulted in the final COPC list per Table 5-2. The method of COPC evaluation is described below.

As noted earlier in this document, the purpose of this sampling program is to develop an assessment of the materials present in the 221-U Facility. This information will support policy decisions regarding the disposition of the facility. For the described purposes, the results are not intended to quantify each COPC in all areas.

The 221-U DQO project team reviewed a considerable amount of process and equipment information for the 221-U Facility and the other site processes that were sources for equipment stored in the Canyon. Appendix C lists all of the potential contaminants that could be associated with specific pieces of equipment from each plant. This information was used to generate a master list of COPCs. The master list was reviewed to determine which of the COPCs present potential risk to human health, cause groundwater degradation, or are concerns for disposal at the 221-U Facility and require sampling and analysis. This list and the reasoning for each COPC are provided in Table 5-2.

Table 5-1. Inputs (Page 1 of 4)

Boundaries	Input	Data Needs/Data Sources
Electrical Gallery	Characterization data for equipment, tanks, etc.	• COPCs: - Radionuclides: ^{241}Am, ^{60}Co, ^{134}Cs, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{237}Np, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{228}Ra, ^{90}Sr, ^{228}Th, ^{234}U, ^{235}U, ^{238}U (from Table 2-1, pg. 2-18 of DOE/RL-97-11) - PCBs (breakers, switch gear) - Hg (sumps - collection points for condensate leakage, rainwater, liquid spills) - RCRA metals - Asbestos - Th (glass on equipment panels) - Biological contamination from "critters" - Electrical hazards (hot wires/wiring systems) • Class C or less - can be determined through rad survey data already available • Liquids - sumps are liquid collection points. At least one sump continues to collect liquid. • Liquids in pipes - verify that pipes in the Electrical Gallery contain no free standing liquid. If they do contain free standing liquid, determine if removal of the liquid is necessary. If no liquid is found, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for the purposes of health & safety or inventory limits.
	Type, location, condition, amount of materials	No materials stored in the Electrical Gallery
Piping Gallery	Characterization data for equipment, tanks, etc.	• COPCs: - same as Electrical Gallery, except electrical hazards - Add process reagents: acetylene tetrabromide, Pb, TBP, bismuth phosphate, selenium, HNO_3 (from Table 2-1, pg. 2-18 of DOE/RL-97-11) - Add kerosene (DEOBASE™) • Class C or less - can be determined through rad survey data already available • Liquids - verify that pipes in the Electrical Gallery contain no free-standing liquid. If they do contain free standing liquid, determine if removal of the liquid is necessary. If no liquid is found, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for the purposes of health & safety or inventory limits.
	Type, location, condition, amount of materials	No materials stored in the Piping Gallery

Table 5-1. Inputs (Page 2 of 4)

Boundaries	Input	Data Needs/Data Sources
Operating Gallery	Characterization data for equipment, tanks, etc.	• COPCs: - same as Electrical Gallery - Add red oil (manometers) • Class C or less - can be determined through rad survey data • Liquids -verify that pipes in the Electrical Gallery contain no free-standing liquid. If they do contain free-standing liquid, determine if removal of the liquid is necessary. If no liquid is found, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for the purposes of health & safety or inventory limits. - Strong possibility of cross-contamination between process flow pipes & instrument valves - Determine whether shower drains & incoming pipes are empty. If not empty, take action to characterize & remove liquid.
	Type, location, condition, amount of materials	No materials stored in the Operating Gallery
Crane Way	Characterization data for equipment, tanks, etc.	• COPCs: - same as Electrical Gallery, except drop PCBs • Class C or less - can be determined through rad survey data • Liquids - none expected
	Type, location, condition, amount of materials	No materials stored in the crane way or crane cab
Ventilation Tunnel	Characterization data for equipment, tanks, etc.	• COPCs: - same as Electrical Gallery, except drop PCBs & asbestos - Add process reagents: Pb, TBP, $BiPO_4$, Se, HNO_3, (from Table 2-1, pg. 2-18 of DOE/RL-97-11 Phase 1 FS) • Class C or less - no rad survey data for Ventilation Tunnel • Liquids - none likely, condensate has probably evaporated
	Type, location, condition, amount of materials	No materials stored in the Ventilation Tunnel
Hot pipe trench	Characterization data for equipment, tanks, etc.	• COPCs: - same as Electrical Gallery - Add process inflows: uranyl nitrate hexahydrate - Add process reagents: acetylene tetrabromide, Pb, TBP, bismuth phosphate, selenium, HNO_3 (from Table 2-1, pg. 2-18 of DOE/RL-97-11) - Add process feed materials: UNH, H^+, Na^+, SO_4^+, PO_4^+, NO_3^-, Cl^-(from HW- 19140, Technical Manual, Nov. 10, 1951) • Class C or less - no rad survey data for hot pipe trench • Liquids - unknown nature/amounts in pipes.

Table 5-1. Inputs (Page 3 of 4)

Boundaries	Input	Data Needs/Data Sources
Hot pipe trench (cont.)	Type, location, condition, amount of materials	No materials stored in the hot pipe trench
Cells	Characterization data for equipment, tanks, etc.	Definition of process equipment: equipment within the cells that is jumpered to the walls or otherwise installed • COPCs: - same as Electrical Gallery - Add process inflow: uranyl nitrate hexahydrate - Add process reagents: acetylene tetrabromide, Pb, TBP, bismuth phosphate, selenium, HNO_3 (from Table 2-1, pg. 2-18 of DOE/RL-97-11) - Add COPCs from PUREX, REDOX, B Plant • Class C or less - no rad survey data for Cells • Liquids - unknown nature/amounts in process equipment and tanks within the cells - If liquid is found, sample for process COPCs - If no free standing liquid is found, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for purposes of health & safety or inventory limits
	Type, location, condition, amount of materials	Definition of " disposed material": any piece of equipment or debris that is not process equipment or cannot be determined as process equipment • COPCs: - same as Electrical Gallery - Add process inflow: uranyl nitrate hexahydrate - Add process reagents: acetylene tetrabromide, Pb, TBP, bismuth phosphate, selenium, HNO_3 (from Table 2-1, pg. 2-18 of DOE/RL-97-11) - Add COPCs from PUREX, REDOX, B Plant • Class C or less - no rad survey data for non-process equipment within cells • Liquids - unknown nature/amounts in process equipment and tanks within the cells - If liquid is found, sample for all COPCs - If empty, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for the purposes of health & safety or inventory limits • Liquids - unknown nature/amount within the cells themselves - Sample Cell 10 first...it is the collection point for liquids from the rest of the building, except the galleries and crane way - Will give an indication of what might be in the other cells - Will give an indication of what might be in underground pipe

Table 5-1. Inputs (Page 4 of 4)

Boundaries	**Input**	**Data Needs/Data Sources**
Canyon Deck Crane	Characterization data for equipment, tanks, etc.	Definition of "disposed material": all equipment and debris on the canyon deck
	Type, location, condition, amount of material	• COPCs: - same as for the Cells • Class C or less - no rad survey data • Liquids - unknown nature/amounts in equipment - if liquid is found, sample for all COPCs - If no free-standing liquid is found, assume remaining residual contamination will not greatly contribute to the radionuclide or chemical inventory for the purposes of health & safety or inventory limits

Table 5-2. COPC Logic (Page 1 of 3)

Compound	Remain a COPC (Y/N)	Sample for COPC in Liquids (Y/N)	Sample for COPC in Solids/Sludges (Y/N)	Sample for COPC in Concrete (Y/N)	Reasoning
Acetylene Tetrabromide	Y	N	N	N	Material has been identified by process knowledge. Found in manometers. Is a red viscous oil. Can be identified by visual inspection. Rad survey.
Aluminum (fines)	Y	N	N	N	Not a risk. Visual inspection for via top of dissolver.
Aluminum Nitrate Nonahydrate	Y	Y	Y	N	Sample for nitrate in liquids. Sample for nitrate in solids/crystals. Would not sample for nitrates in concrete unless crystals are present.
Ammonium Fluoride/Ammonium Nitrate	Y	Y	Y	N	Sample for Fluoride ion in liquids or solids but not in concrete.
Asbestos	Y	N	N	N	Assume pipe insulation is asbestos. Use good faith asbestos inspection.
Bismuth Phosphate	N				Not a risk.
Citric Acid	N	Y	N	N	Footnote 1
Di-2-(ethylhexyl)phosphoric acid (D2EHPA)	N	Y	N	N	Footnote 1
Diatomaceous Earth	N				Not a risk
Ethylenediamine tetra-acetic acid (EDTA)	N	Y	N	N	Footnote 1
Ferrous Ammonium Sulfate	N				Not a risk.
Hexone	Y	Y	N	N	May be in liquids, screen for VOCs.
Hydroxyacetic acetic acid (ACOH)	N	Y	N	N	Footnote 1
Hydroxyethylene diamine triacetic acid (HEDTA)	N	Y	N	N	Footnote 1
Kerosene	Y	Y	N	N	Would only look for it in liquids.
Lead (Bricks/Shielding)	Y	N	N	N	Visual identification, estimate quantity.
Lead (Other)	Y	N	Y	N	Volume of lead in concrete or liquids is small risk compared to lead shielding/bricks.
Mercury	Y	Y	Y	N	Visual & historical knowledge has identified mercury in switches/ manometers. Mercury from spills may be present in sludge/sumps.
Nitric Acid	Y	Y	N	N	Check pH in liquids, Would not be expected in solids (reacted) or concrete (neutralized).
Normal Paraffin Hydrocarbons (NPH)	Y	Y	N	N	Test liquids only, screen for VOCs
Oil/Grease	N				No specific compounds for oil or grease
Phosphoric Acid	Y	Y	N	N	Liquids only check for pH, acid would be neutralized by concrete. Phosphate low risk.

Table 5-2. COPC Logic (Page 2 of 3)

Compound	Remain a COPC (Y/N)	Sample for COPC in Liquids (Y/N)	Sample for COPC in Solids/Sludges (Y/N)	Sample for COPC in Concrete (Y/N)	Reasoning
Polychlorinated Biphenyls (PCBs)	Y	Y	N	N	Check only oils associated with electrical equipment for PCBs.
Potassium Hydroxide	N				pH of liquids only, no risk other than pH.
Potassium Permanganate	N				Not a hazardous material, no risk driver, manganese is a secondary ground water contaminant.
Rare earth nitrate	N				Nitrate is already being sampled for. Rare earths aren't chem. specific.
Selenium	N				Has not been identified in any process.
Sodium Carbonate	N				Not a risk
Sodium Chloride	N				Not a risk
Sodium Dichromate	Y	Y	Y	N	Unless in liquid form and alkaline, insignificant amounts would be present from REDOX. Would test for pH >7.0 and if so run a total chromium analysis. Would run a total chromium for sludge material.
Sodium Gluconate	N				Not a risk.
Sodium Hydroxide	Y	Y	N	N	Check the pH of liquids only.
Sodium Nitrate	Y	Y	Y	*	Liquids only for nitrate. * - See Aluminum Nitrate Nonahydrate for test solids & concrete.
Sodium Nitrite	Y	*	*	*	* - Nitrite would most likely have changed to nitrate. Would sample for nitrate.
Sodium Sulfate	N				Not a risk.
Sugar	N				Not a risk.
Sulfamic Acid	Y	Y	N	N	Check pH of liquids and moist sludges. Would have reacted with concrete.
Tributyl Phosphate	Y	Y	N	N	noncarcinogen, limited toxic effects analyze only in organic, non-oil phase of liquid in Tank 5-6
Uranyl Nitrate Hexahydrate	Y	N	N	N	Will be identified when looking for Uranium (rad) and nitrate.
Zirconium (fines)	Y	N	N	N	Visual inspection of dissolvers to identify Zr. Identify same as aluminum.
Am-241	Y	Y	Y	Y	
Co-60	Y	Y	Y	Y	
Cs-134	N				Short half life.
Cs-137	Y	Y	Y	Y	
Eu-152	Y	Y	Y	Y	
Eu-154	Y	Y	Y	Y	
Np-237	Y	Y	N	Y	low yield alpha emitter, not detectable

Table 5-2. COPC Logic (Page 3 of 3)

Compound	Remain a COPC (Y/N)	Sample for COPC in Liquids (Y/N)	Sample for COPC in Solids/Sludges (Y/N)	Sample for COPC in Concrete (Y/N)	Reasoning
Pu-238	Y	Y	Y	Y	
Pu-239/240	Y	Y	Y	Y	
Ra-226	N				Only a minor contribution (WHC 1996)
Ra-228	N				Only a minor contribution (WHC 1996)
Sr-90	Y	Y	Y	Y	
Th-232	Y	Y	Y	Y	Was previously identified as Th-228; however, Th-228 is a short-lived daughtd of Th-232
U-234	Y	Y	Y	Y	
U-235	Y	Y	Y	Y	
U-238	Y	Y	Y	Y	
Gross Alpha	Y	Y	Y	Y	
Gross Beta	Y	Y	Y	Y	
GEA	Y	Y	Y	Y	

[1]Because the B-Plant equipment would have been drained before moving it to U Plant, there is no reason to believe it will be present in significant quantities. If large volumes are encountered, the liquid will be removed, eliminating any potential risk.

5.4 DATA QUALITY OBJECTIVE STEP 4: BOUNDARIES

Step 4 of the DQO Process defines the physical and temporal boundaries of the problem. The spatial (physical) boundaries are discussed below. Temporal boundaries are important when contaminant concentration changes (over time) are significant. The facility has been shut down since 1958 and no obvious temporal effects are noted.

5.4.1 Physical Boundaries

As seen through Table 5-1, the 221-U Canyon structure has been segregated into four areas for purposes of this investigation.

- Service Galleries. These galleries are in the service part of the structure, including the electrical gallery, piping gallery, and operating gallery. These areas are the parts of the facility where personnel did routine maintenance and operating functions. Overall, protection was not required in these areas and the existing levels of contamination present limited exposure concerns. Sampling for this area is more to confirm the absence of contamination than to establish inventory. The crane way is grouped with the service galleries, based on existing radionuclide survey information for that area.

- Canyon Deck. The Canyon area was exposed to elevated levels of radiological contamination through spills and normal process operations. In addition, there is a significant inventory of contaminated equipment on the canyon deck that has an undetermined radiological and chemical inventory. Although the crane way air space is in direct communication with the air above the Canyon, there is no evidence that this has resulted in significant exposure concerns in the crane way.

- Process Support Areas. The hot pipe trench and the Ventilation Tunnel were exposed to high levels of radiation and retain significant levels of radiological contamination. The ventilation tunnel was exposed to all of the potential airborne COPCs found in the process areas of the structure. The hot pipe trench transferred the process materials to the process cells; there was likely some amount of leakage within this trench.

- Cells. The process cells were exposed to the highest levels of radiological contamination in the facility. Leaks from process lines and spills from process vessels would have been contained within the cells and drained via floor drains to cell 10.

5.4.2 Sample Media/Matrix

Within each area described above, there are two types of sampling that will take place. Concrete samples and surveys will determine the ambient levels of contamination and be used to assess the total inventory for a given area. Analyses also will be conducted for piping and equipment in these areas. These analyses will ascertain the levels of concern associated with particular pieces of equipment and will also contribute to an understanding of the total radionuclide and chemical inventory for the facility.

Concrete analyses generally will be limited to surface analyses for radionuclides. An exception to this approach will be used for the cells, where cores will be sampled in order to determine the penetration of contaminants into the concrete. Specific non-rad constituents will be sampled for if process knowledge suggests that there is a reason to believe that the compound might be present and there is visible evidence to point to a sample location.

5.5 DATA QUALITY OBJECTIVE STEP 5: DECISION RULE(S)

Figure 5-1 Provides the decision logic based on Section 5.2. The logic diagram negates the need for "if . . . then" statements normally included in the DQO that provide the decision limits and resulting actions. Table 5-3 lists the criteria for the decision limits or identifies the reference document that provides the decision limits used in the decision logic.

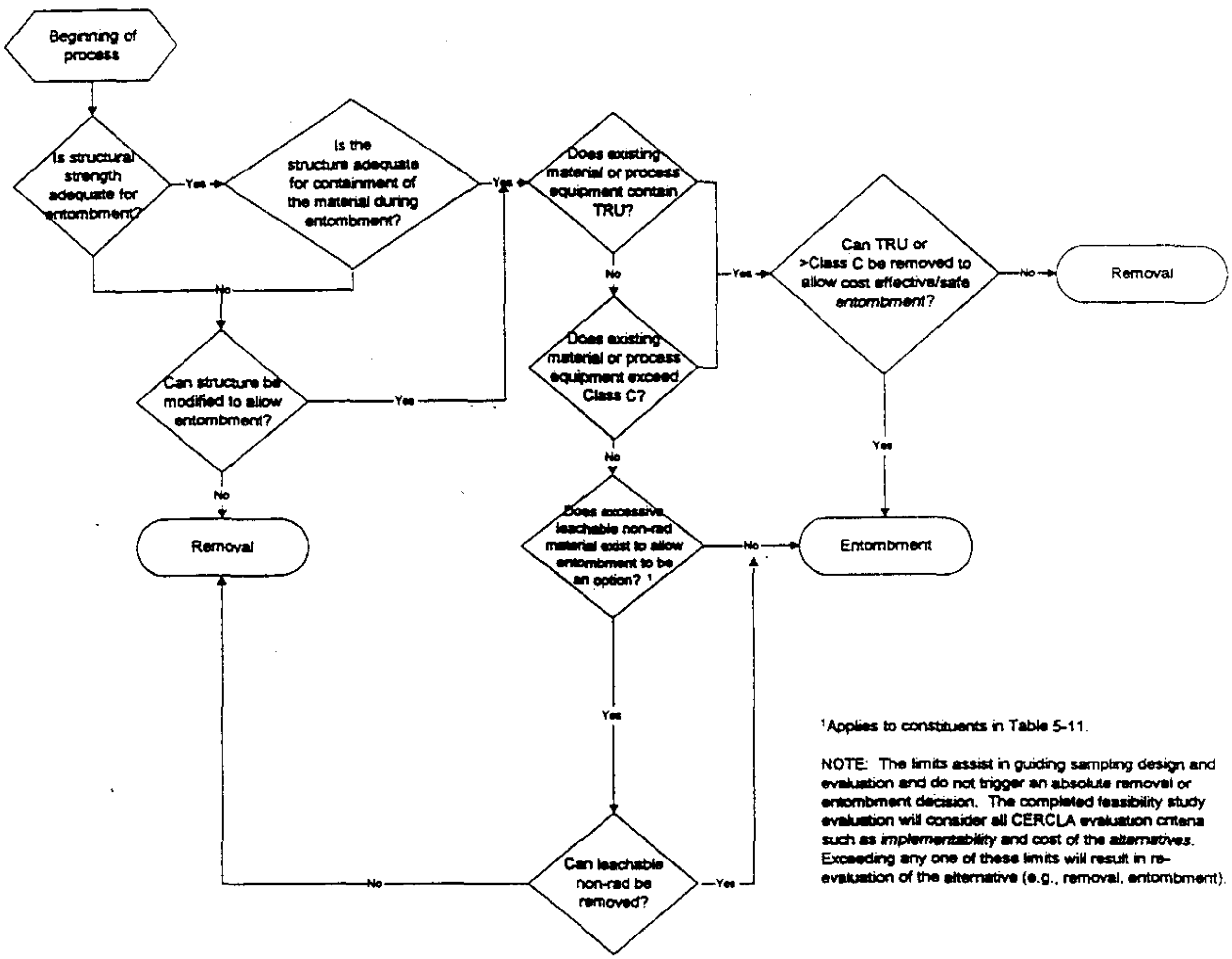
The assessment of the protection of groundwater will be based on models of fate and transport and risk to human health and the environment. These models are currently under evaluation by DOE, EPA, and Ecology, external to this project. However, the technical team reviewed the typical parameters in the models to assure that the data collection for this project includes the information used by the models.

Besides the logic provided, the additional criteria required by CERCLA and RCRA for evaluation of disposition alternatives will be examined in the disposition assessment. These additional criteria include risk evaluation, implementability, cost of the disposition alternative, and effectiveness (EPA 1988).

Table 5-3. Decision Limit Criteria

Criteria/Decision Limit	Criteria Reference
TRU	Transuranic waste is defined as "Waste (without regard to source of form) that is contaminated with alpha emitting transuranium (TRU) radionuclides with an atomic number >92 and with half-lives greater than 20 years and concentrations greater than 100 nCi/g alpha per gram of waste at the time of assay." In addition Radium sources and waste with U-233 concentrations greater than 100 nCi/g of the waste matrix are managed as TRU waste. Transuranic elements are actinides with atomic numbers from 93 (neptunium) through 103 (lawrencium). Most have isotopes with half-lives of the order of minutes or less and, thus, are not of substantive health concern. The nuclides of greatest interest in radiation protection are typically Np-237, Pu-238, Pu-239, Am-241, and Cm-244.
Class C	WHC (1996)

Figure 5-1. Decision Logic



[1]Applies to constituents in Table 5-11.

NOTE: The limits assist in guiding sampling design and evaluation and do not trigger an absolute removal or entombment decision. The completed feasibility study evaluation will consider all CERCLA evaluation criteria such as *implementability* and cost of the *alternatives*. Exceeding any one of these limits will result in re-evaluation of the alternative (e.g., removal, entombment).

5.6 DATA QUALITY OBJECTIVE STEP 6: SPECIFY TOLERANCE LIMITS ON DECISION ERRORS

5.6.1 Purpose

Step 6 of the DQO Process is used to specify the acceptable limits on decision errors. These limits will be used in Step 7 of the DQO Process to develop an adequate sampling design for the intended data use.

One set of decision limits for the 221-U DQO is based on the Environmental Restoration Disposal Facility (ERDF) Waste Acceptance Criteria (WAC) (BHI 1996). The following text discusses decision errors and the consequences of making an incorrect decision.

One of the goals of sampling in the 221-U Facility is to estimate the nature and extent of contaminants within the different areas of the facility. Sample results will be compared with ERDF WAC limits for characterization of concrete, equipment, and other materials located within the facility. When making these comparisons, there are two types of possible error associated with the characterization.

Type I One could conclude that the mean concentration of a contaminant is less than the associated decision threshold, when in fact the mean concentration is greater than the decision threshold. In simple terms, this error is concluding that the material is "not regulated waste" when it is actually "regulated waste."

Type II The second type of error would be to conclude that the mean concentration of a contaminant is greater than the associated decision threshold, when in fact the mean concentration is less than the decision threshold. This error is concluding that the material is "regulated waste," when in fact it is actually "not regulated waste."

The typical hypothesis when characterization is the goal is to assume that the material is in the more restrictive class (i.e., assume that the material is greater than the limit); samples may indicate otherwise. This scenario is often chosen because the consequences of concluding that the waste is less than the disposal limit when it actually is greater than the limit are usually the more important consequences to minimize. Under this hypothesis, Type I error is incorrectly concluding that the material is less than the limit and Type II error is incorrectly concluding that the waste is greater than the limit. The error rate for both types of decision errors may be controlled through adequately estimating the number of samples and a designing statistical approach for collecting the samples that is consistent with the conceptual model developed in DQO Steps 1 through 5.

The limits on decision error directly affect the number of samples collected. The decision error depends on the number of samples, the variance of the distribution, the probability of making an incorrect decision, and the decision threshold. To assess the number of samples, the following steps are performed:

1. The variance of the distribution is estimated by the variance of existing data.

2. Decision thresholds are obtained from the ERDF WAC and the definition of TRU.

3. Specification of the rate of one type of decision error is held constant.

4. The rate for the second type of decision error, estimated for the number of samples, is compared to the specified error rate.

5. The number of samples is estimated based on decision error rates, cost, and accessibility and logistics for collecting the samples.

The final step is performed in the optimizing design section (Section 5.7) of this document.

5.6.2 Existing Data Summary

5.6.2.1 Concrete. The existing data available for the 221-U Facility are inadequate to estimate statistically the number of samples required for all of the COPCs in all areas of the facility. The historical data consist of radiological survey results that provide no information about the isotopic distribution of radionuclide contamination. The survey results also do not provide information about the depth of contamination in the concrete. There are several areas of the facility that have no associated information about either radiological or non-radiological contamination. However, the data may be used qualitatively to determine whether isotopic and depth distribution information will be acquired in some areas through sampling or through inference based on sampling that will take place in adjacent areas.

Tables 5-4 through 5-9 show summaries of direct and swipe radiological surveys, and the general dose rate for accessible areas within the facility. Table 5-10 is a summary of the direct and general area dose results for surveys performed on equipment stored on the canyon deck. Swipe samples provide data for removable radiological contaminants. Tables 5-4 through 5-7 show summaries for fixed contamination and general dose rates; Tables 5-8 through 5-10 show summaries for removable contamination for the same areas. Summaries include ranges of detected values, or the detection limit, for alpha and beta/gamma contamination, and general area dose in uR/hr or mR/hr, as noted. All of the survey data summarized in the tables was collected during 1996, except the general dose information presented for the canyon deck. The canyon deck general dose data originate from the Adam's report found in the DQO Scoping Binder (Rugg 1997). None of the boundaries within the facility have associated fixed-laboratory data for either radiological or non-radiological COPCs.

A review of the summary data shows that the dose rates in the canyon are approximately three orders of magnitude greater than the dose rates in the galleries and in the crane way; measurement units are mR/hr from the canyon and uR/hr from the other areas. A statistical comparison was performed to verify the qualitative conclusions. Results of the statistical comparison are presented in Appendix D. Comparison of fixed or loose contamination was not performed because the general dose rate represents both fixed and loose contamination. The conclusions, based on the dose rate comparison, are that the contribution to dose from the entire facility is not greatly increased by the radiological inventory in the galleries or the crane way, and that the application of the isotopic distribution of contamination in the canyon concrete to the concrete in the galleries and crane way will result in a conservatively high estimate of the radiological inventory in these areas.

5.6.2.2 Equipment. Equipment is currently stored in the cells and on the canyon deck. It originates from REDOX, PUREX, B Plant, and U Plant and includes large pieces (i.e., tanks and casks) and small pieces (i.e., valves and buckets). A limited amount of historical data is available for the equipment in the cells; more information is available about equipment on the deck.

Records and interviews indicate that the equipment in the cells consists of U-Plant process equipment and also equipment from the other facilities; it is expected that the equipment in the cells is the most contaminated. It is assumed that non-process equipment being stored in the cells is there because of high associated dose rates.

Process knowledge and dose rate data indicate that the equipment on the deck substantially contributes to the chemical inventory of the facility. Equipment dose rates range from <20 - 14,000 dpm/100 cm^2 alpha and 20 x 10^3 - > 1 million dpm/100 cm^2 beta/gamma (see DQO Scoping Binder [Rugg 1997]). Historical information indicates that the equipment brought into the facility for storage was decontaminated to some extent before being transported to 221-U, but the extent of decontamination is unknown. Some equipment, such as the tanks, may contain liquid. Pieces of equipment that required lubrication may have liquid oil still in their reservoirs.

Video tapes and digital pictures of the equipment on the canyon deck, along with the inventory in the DQO Scoping Binder (Rugg 1997), will be used to create an inventory of the types of equipment being stored. This information will be compiled to determine the sampling approach for the equipment and to determine where to move equipment to implement the sampling plan for the cells and hot pipe trench.

The equipment in the cells consists of 221-U equipment that is still jumpered or otherwise installed, along with equipment whose origin is unknown. The 40 cells have been divided by process (see Table 2-1) and the COPCs associated with each process have been identified. This information may be used to associate COPCs with particular pieces of equipment in the cells.

5.6.3 Decision Errors and Consequences of an Incorrect Decision

Identifying the consequences of making an incorrect decision provides input for determining the decision error rates that are acceptable for the project. Once the consequences are identified, costs, not necessarily monetary, of making an incorrect decision can be considered, resulting in the determination of what level of each error rate is tolerable.

The consequences of concluding that the material is less than the limit when it is actually greater than the limit (error) include the following:

1. an entombment alternative is chosen and cannot be implemented;

2. an entombment option is chosen, implementation begins, and it is discovered that it is not feasible; and

3. an entombment option is implemented and monitoring shows that the facility is not performing properly.

The potential consequences may result in milestone delays, enormous amounts of wasted resources, and human health or ecological safety hazards for several generations.

Concluding that the material is greater than the limit when it is actually less than the limit (error), also has associated consequences, including unnecessary remediation or removal of the facility and loss of credibility. Expensive and unnecessary disposal costs may be incurred for this project and several others at the Hanford Site, and milestones may be renegotiated unnecessarily.

Relating the above consequences to the costs of making an incorrect conclusion are difficult to quantify. As described below, the error rate will not be specified in advance, but will be determined when a data quality assessment (DQA) is performed for the data that will be collected as a result of this DQO Process.

A statistical design offers the opportunity to control decision error rates. A statistical estimation of the number of samples required to meet error tolerances is not feasible because there are no data available to estimate the mean and variance, which are required to perform the calculations. A stratified, random sampling design is possible for the canyon deck, but the number of samples cannot be statistically determined before sampling because of the lack of historical data. Therefore, the number of samples to collect from each area (stratum) on the canyon deck will be determined by best professional judgement, with the understanding that once the data are collected, error rates will be quantified as part of a DQA and additional sampling may be required. Biased sampling will take place in the cells, based on cell function and accessibility. The radiological results of sampling the concrete of the canyon deck and the cells will be used to estimate the isotopic distribution of radiological COPCs. This distribution will be used to determine concentrations in the galleries and other areas of the facility that have only radiological survey data.

Table 5-4. Summary of Direct Radiological Survey Data and General Area Dose Data for the Galleries

Section	Gallery								
	Electrical			Piping			Operating		
	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose (uR/hr)	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose (uR/hr)	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose (uR/hr)
1[a]	N/A	N/A	N/A	N/A	N/A	N/A	<20	2 - 35	7 - 11
2[b]	<20	2 - 8	9	<20	5 - 15	10			
3	<20	<1	10	<20	2 - 5	9 - 10	<20	<1	8
4	<20	3 - 10	9 - 10	<20	10 - 50	11	<20	10	7 - 8
5	<20	1 - 72	9	<20	40 - 50	20 - 50	<20	<1	7 - 8
6	<20	3 - 20	9 - 10	<20	2	10 - 30	<20	8 - 20	8 - 9
7	<20	4.5 - 55	9 - 10	<20	<1	9	<20	2	8 - 9
8	<20	10 - 25	9 - 11	<20	10 - 25	9 - 10	<20	5 - 40	9
9	<20	4 - 20	9 - 10	<20	30	9 - 10	<20	3 - 5	8
10	<20	25	9	<20	<1	9 - 10	<20	5	9
11	<20	10 - 50	9 - 10	<20	<1	9 - 10	<20	25	8 - 9
12	<20	2.5 - 12	9	<20	2	8	<20	20	8
13	<20	8	10 - 11	<20	2	9	<20	<1	8
14	<20	20	9 - 10	<20	<1	8 - 9	<20	20	9
15	<20	4 - 15	9 - 10	<20	<1	9	<20	20	8 - 9
16	<20	<1	9 - 11	<20	<1	9 - 10	<20	35	8 - 9
17	<20	4	9	<20	<1	9 - 10	<20	5 - 40	9 - 10
18	<20	<1	9 - 11	<20	4 - 20	9	<20	<1	8 - 9
19	<20	<1	9 - 10	<20	10 - 125	9 - 10	<20	4 - 30	8 - 9
20	<20	<1	9 - 40	<20	<1	9 - 150	<20	<1	9 - 10

[a]The electrical and piping galleries do not extend into Section 1. The operating gallery contains showers and a changing area in Sections 1 and 2.
[b]This Section is half the size of the other Sections, in each the galleries, except the operating gallery.

Table 5-5. Summary of Direct Radiological Survey Data for the Stairwells Between Galleries

Stairwell	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose (uR/hr)
7[a]	<20	2 - 40	7 -8
Stairwell to crane way	N/A	N/A	< 0.5 mR/hr
15	<20	1 - 5	7 - 8
9	< 20	N/A	6 - 8
17	<20	<1	8
1	<20	2 - 25	7 - 11

[a] Some areas were not surveyed due to evidence of animal intrusion.

Table 5-6. Summary of Direct Radiological Survey Data for the Canyon and Crane Way

Section	Crane Way			Canyon Deck		
	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose (mR/hr)	Alpha (dpm)	Beta/Gamma (10^3 dpm)	Dose[a] (mR/hr)
1	<20	20	<0.5 - 2	N/A	N/A	<0.5 - 6
2	<20	N/A	<0.5	N/A	N/A	0.5
3	<20	N/A	<0.5	N/A	N/A	0.7
4	<20	100	<0.5	N/A	N/A	1
5	<20	N/A	<0.5	N/A	N/A	1.5 - 90
6	<20	N/A	<0.5	N/A	N/A	2 - 84
7	<20	N/A	<0.5	N/A	N/A	1 - 3.5
8	<20	N/A	0.8	N/A	N/A	1
9	<20	N/A	1	N/A	N/A	1.5 - 6
10	<20	N/A	<0.5	N/A	N/A	1
11	<20	N/A	<0.5	N/A	N/A	1 - 60
12	<20	N/A	<0.5	N/A	N/A	2 - 8
13	<20	N/A	<0.5	N/A	N/A	N/A
14	<20	N/A	<0.5	N/A	N/A	5
15	<20	N/A	<0.5	N/A	N/A	N/A
16	<20	80	<0.5	N/A	N/A	1.5 - 2
17	<20	N/A	<0.5	N/A	N/A	3.5 - 25
18	<20	22	0.5	N/A	N/A	N/A
19	<20	80	<0.5	N/A	N/A	96
20	<20	10	0.8	N/A	N/A	510

[a]These values are from the Adams report; 1996 survey data are mostly non-detect

Table 5-7. Summary of Direct Radiological Survey Data for the Canyon Deck

Section	Alpha (dpm/100 cm^2)	Beta/Gamma (10^3 dpm/100 cm^2)
1	<20	20 - 50
2	<20	4 - 20
3	<20	7 - 700
4	<20	10 - 60
5	<20 - 420	40 - 100
6	< 20 - 700	10 - >10^3
7	< 20	10 - 60
8	> 20 - 420	70 - 200
9	700 - 7,000	30 - 100
10	14,000	200
11	280 - 1,400	8 - >10^3
12	280 - 700	100 - 200
13	<20 - 700	65 - 300
14	560 - 140,000	200 - >10^3
15	14 - 1,400	10 - 400
16	280 - 4,900	7 - >10^3
17	< 20 - 280	10 - 80
18	<20 - 280	4 - 30
19	<20 - 280	10 - 70
20	< 20	1 - 25

Table 5-8. Summary of Removable Radiological Survey Data for the Galleries and Crane Way (Page 1 of 2)

Section	Gallery						Crane Way	
	Electrical		Piping		Operating			
	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)
1	N/A	N/A	N/A	N/A	<20	<1 - 5	<20	1 - 5
2	<20	<1	<20	<1			<20	25
3	<20	<1	<20	<1 - 2	<20	N/A	<20	N/A
4	<20	1 - 3	<20	<1	<20	<1	<20	2
5	<20	1 - 9	<20	<1	<20	N/A	<20	3
6	<20	<1	<20	<1	<20	<1	<20	N/A
7	<20	< 1 - 3	<20	<1	<20	<1	<20	4
8	<20	<1	<20	<1	<20	<1	<20	4
9	<20	<1	<20	<1	<20	<1	<20	5 - 20

Table 5-8. Summary of Removable Radiological Survey Data for the Galleries and Crane Way (Page 2 of 2)

Section	Gallery						Crane Way	
	Electrical		Piping		Operating			
	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)	Alpha (dpm/ 100 cm^2)	Beta/Gamma (10^3 dpm/ 100 cm^2)
10	<20	<1	<20	N/A	<20	<1	<20	3
11	<20	<1 - 2	<20	<1	<20	<1	<20	8
12	<20	<1	<20	N/A	<20	<1	<20	2
13	<20	<1	<20	<1	<20	N/A	<20	1
14	<20	5	<20	N/A	<20	<1	<20	25 - 100
15	<20	<1	<20	N/A	<20	<1	<20	4 - 15
16	<20	<1	<20	N/A	<20	<1	<20	4
17	<20	<1	<20	<1	<20	<1	<20	4
18	<20	N/A	<20	N/A	<20	N/A	<20	4 - 5
19	<20	<1	<20	<1	<20	<1 - 15	<20	2
20	<20	<1	<20	<1	<20	<1	<20	1 -10

Table 5-9. Summary of Removable Radiological Survey Data for the Stairwells between Galleries

Stairwell	Alpha (dpm/100 cm^2)	Beta/Gamma (10^3 dpm/100 cm^2)
7[a]	<20	<1 - 2
Stairwell to Crane Way	N/A	N/A
15	<20	2 - 3.5
9	N/A	N/A
17	N/A	N/A
1	<20	<1

[a]Some areas were not surveyed due to evidence of animal intrusion.

Table 5-10. Summary of Removable Radiological Survey Data for Equipment on the Canyon Deck

Description	Location Section(s)	Alpha (dpm/100 cm^2)	Beta/Gamma (10^3 dpm/100 cm^2)
wheel barrow	1	<20	10
impact wrench	1	<20	10
sink	2, 10	<20 - 700	20 - 100
piping	2, 5, 7, 12, 13, 15	<20 - 2,800	10 - 900
cabinet	3, 6	<20 - 420	41 - 400
centrifuge	3, 4, 7, 12, 16	<20 - 4,200	30 - >1,000
pump	4	<20 - 420	100 - 200
tanks	5, 6, 7, 8, 10, 12, 15	<20 - 2,100	50 - 700
drums	9	14,000 - 41,000	80 - 300
agitator	9, 13, 14	1,400 - 2,100	10 - >1,000
vessel	9	1,400 - 3,800	200 - 300
jumper components	11, 16	280	30
lifting yoke	11	700	>1,000
ventilator assembly	11	140	40
condenser column	12	280 - 420	100 - 150
motor	12	<20 - 420	50 - 150
pot	13, 16	<20 - 280	30 - 70
cask	14, 16, 17, 18	<20 - 140	15 - 900
"A" frame	14	140	8
platform	15	420	60
off gas heater	15	140	10
condenser	16	<20 - 140	50 - 65
dissolver	17, 18	700 - 2,800	10 - 50
miscellaneous*	3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	not available	not available

*plastic, wood, buckets, pallets, metal, fuel holder, tripod, welder, paper, table.

5.7 DATA QUALITY OBJECTIVE STEP 7: OPTIMIZATION

The purpose of Step 7 of the DQO Process is to develop a sampling strategy that satisfies the requirements of the previously described DQO steps. The order in which the designs are presented does not imply that the order of sampling will be the same. The designs for the canyon deck and cells are presented first because results from sampling these areas will be applied to other areas, such as the galleries, where additional radiological sampling is not proposed.

5.7.1 Canyon Deck

5.7.1.1 Concrete. Based on the historical survey data, the canyon deck is an area where the removable contamination and general dose rates are highest. It represents one of the worst-case areas in terms of concentration of most of the COPCs; however, no isotopic or depth of distribution data for any COPCs are available. A two-phased sampling approach using stratified biased sampling is planned.

Process knowledge and dose rate data indicate that the walkway area of the deck has relatively lower levels of contamination when compared with the areas over the cells and hot pipe trench. The dose rate is higher in these areas because of the processes that took place there and the equipment is now being stored on top of the cover blocks. Based on this information, it is reasonable to divide the canyon deck into three strata: the walkway, areas (not on the walkway) where equipment is not stored but may have been in the past, and areas where equipment is currently being stored (equipment will not be moved to collect Phase I samples). It is anticipated that this location may substantially contribute to the total variability; therefore, stratifying in this manner will take location into account.

A phased sampling approach is recommended so an initial amount of information may be gathered, not only for the characterization of the canyon deck, but also to provide information that will be applied to other areas of the facility that also do not have associated isotopic distribution or depth data. Phase I involves collecting 3 samples in each of the three strata, locations will be biased by survey information or visual inspection for staining; the number of Phase II samples will be determined based on a DQA of the Phase I data.

The number of samples for the Phase I stage of data collection is based on professional judgement. A total of 9 samples will be collected during Phase I; it is anticipated that stratification will provide reasonable coverage, based on the assumption that geographical location is an important source of variability. Only surface samples will be collected because there is no driver for COPCs to penetrate the concrete. If the DQA of these data indicates that the COPCs have not been adequately characterized, additional samples may be collected. Each sample will be analyzed for all of the COPCs.

5.7.1.2 Equipment. Process knowledge and dose rate data indicate that the equipment on the deck substantially contributes to the chemical inventory of the facility. Equipment dose rates range from <20 - 14,000 dpm/100 cm^2 alpha and 20 x 10^3 - > 1 million dpm/100 cm^2

beta/gamma. The first step in characterizing the equipment is to identify the locations and types of equipment that are currently being stored. This information will also be used in the Phase I concrete sampling described above. Table 5-10 lists specific pieces of equipment identified and surveyed in 1996.

The inventory will be created from the video, digital pictures, and historical inventory and will be used to classify the equipment into categories, such as dissolver, centrifuge, etc., so that representative samples can be collected. If the equipment cannot be classified by function/origin (i.e., a dissolver tank from B Plant), it will be classified by available dose rate information (Rugg 1997 and Table 5-10) into low, medium, and high dose rate categories.

Once the equipment is categorized, the data that will be collected will include the determination of the presence of liquid, the collection survey data, and, possibly, the collection of a liquid sample. Each piece of equipment that may have contained liquid will be non-intrusively examined to determine the presence or absence of free-standing liquid. If free-standing liquid is found, it will be noted, and its volume estimated and sampled, if possible. Oil reservoirs will be sampled if oil is associated with electrical equipment and will be analyzed for polychlorinated biphenyls (PCBs). The large- and medium-sized pieces of equipment will be assessed for size of void space.

If possible, at least 2 liquid samples from each category of equipment (function/origin or dose rate) will be collected and analyzed for all COPCs if the function/origin cannot be determined. At least three pieces of equipment in each category will also be surveyed for general dose and gamma scan. The total number of samples will not be known until the number of categories is determined. Shipping casks, barrels, and other storage equipment will be examined to determine if fuel or other materials are still present.

5.7.2 Cells

5.7.2.1 Concrete. A limited amount of historical data exists for the cells. Each cell has been identified with one or more processes (see Table 2-1): 20 uranium recovery cells, 10 residual material treatment cells, 8 solvent treatment cells, and 8 miscellaneous function cells. Historical information indicates that equipment from other facilities (REDOX, PUREX, B Plant) is stored in some cells. It is anticipated that the equipment in the cells is the most highly contaminated in the facility.

Non-destructive assay for TRU materials and for criticality potential will be performed as each cell is opened. The concrete in the cells will be sampled so that each process is represented; ideally, the concrete associated with multiple processes will be accessible and sampled. The equipment on top of the cells and hot pipe trench will be moved so that each cell may be opened, video taped and examined, and surveyed to obtain general area dose and gamma-scan data. Some cells may be so full of equipment or liquid that collection of a concrete sample is not possible. The goal of sampling will be to collect at least 2 concrete cores from every process, as early in the implementation of the SAP as possible. If a sample cannot be collected from the same-process cells early in the sampling activities, a sample will be collected from the concrete in the hot pipe trench adjacent to the process cells.

The goal during sample collection will be to collect a core as near the drain as possible or where staining is present, so that potential worst-case contamination may be determined. Each core will be 15.24 to 20.32 cm (6 to 8 in.) long, and will be scanned to determine the vertical distribution of contamination. Sample material will be analyzed from the surface of the core and from the deepest interval at which contamination is present, based on the scan. This will result in depth of penetration data and the isotopic distribution of COPCs for the cells, and also other areas where depth information and isotopic distribution are not available.

Once two samples from every process are sampled, additional samples will be collected based on the judgement of the field team about the condition of a cell compared with previous cells. For example, if a uranium process cell is encountered that looks more stained than previous uranium process cells, or has non-process equipment stored in it, and the stained areas or the floor is accessible, a sample will be collected. If the floor concrete is not accessible, but wall concrete can be accessed, a sample of wall concrete (biased toward areas of staining) will be collected. At the end of the sample collection activities, samples from same-process cells will be selected for laboratory analysis so that at least two, and at most three, samples from each process will be analyzed. The samples from locations nearest the drains or where the most staining occurred will be selected for laboratory analyses. If a determination cannot be made about which sample(s) are most representative, samples will be randomly selected.

5.7.2.2 Equipment. Historical data associated with the equipment in the cells is limited. Pictures and videos indicate that some cells are empty, some still have equipment installed, and some have equipment stored from other facilities. When the cells are uncovered for characterization, an inventory of equipment present will be recorded and still or video pictures will be taken. The equipment that is jumpered or otherwise installed will be classified as process equipment; all other equipment in a cell will be classified as non-process equipment. This classification will help guide sample collection and determine what analyses will be performed.

If possible, each piece of process equipment that may have contained liquid will be non-intrusively examined to determine the presence or absence of free-standing liquid. If free-standing liquid is found, it will be noted, and its volume estimated and sampled, if possible. The liquid and sludge in the cell 10 tank (tank 5-6) will be sampled, so that each can be analyzed in the event no other liquid samples can be collected; the sludge sample will be used for the characterization of the pipe drain in case a sludge sample cannot be collected there. Oil reservoirs will be sampled if oil is associated with electrical equipment. Each piece of non-process equipment that may have contained liquid will be examined in the same manner as the process equipment; volume estimates of liquid and oil will be calculated. Liquid samples will be collected from the equipment only if a similar type of equipment on the canyon deck has not been previously sampled.

The goal of sampling the equipment in the cells is to obtain at least one liquid sample to represent each process and to obtain a representation of the non-process liquid that may be present. Therefore, process equipment sampling should result in 1 to 4 samples, dependent upon the amount of liquid that is present in the process equipment. If no liquid is found in the process equipment, other than in tank 5-6 (cell 10), the cell 10 liquid sample will be analyzed. Otherwise, the samples that will be analyzed are the ones from the cells with the highest survey readings or the largest amount of liquid.

The number of samples from the non-process equipment that will be analyzed will not be known until the types of equipment are understood and the amount of liquid is known. If no liquid is present, or similar types of equipment on the canyon deck were sampled, no samples from the non-process equipment in the cells may be analyzed. At the other extreme, every piece of non-process equipment may be sampled, resulting in several samples that will be analyzed.

5.7.3 Pipe Drain

The pipe drain is considered a special case of the cells, because liquid from the cells drained to cell 10 via the pipe drain. The COPCs related to the drain pipe are all of the possible process COPCs from the 221-U Facility, and also the COPCs related to the other facilities where stored equipment may have originated. The historical data associated with the pipe drain is limited to engineering drawings.

Characterization data that will be collected include a video tape to assess the structural integrity of the pipe and where liquid may be draining from; a scale or sludge sample to obtain the isotopic distribution of radiological COPCs and the inventory of non-radiological COPCs; and a radiological survey of the pipe (gamma scan) to correlate with the isotopic distribution obtained from the scale/sludge sample. If the scale/sludge sample cannot be collected, the gamma-scan data from the pipe drain will be compared with the gamma-scan data from tank 5-6 (cell 10) to determine whether the sludge sample from tank 5-6 may be considered to characterize the pipe drain. Otherwise, the isotopic distribution and chemical inventory will be inferred by correlating the gamma-scan data from the pipe with the isotopic and chemical data from the cells' concrete results.

5.7.4 Hot Pipe Trench

5.7.4.1 Concrete. The historical information from the hot pipe trench is limited to engineering drawings. Evidence that anyone ever visited the hot pipe trench has not been discovered. Due to the large number of pipes and their configuration within the trench, accessibility to the concrete is a major issue when considering what concrete data are necessary from the hot pipe trench. Because of accessibility issues, the proposal is to avoid the collection of any samples from the hot pipe trench concrete by calculating the radiological and chemical inventory based on the results of concrete samples in the process cells and a remote survey (gamma scan) of the trench. An instance when samples may be collected from the concrete in the hot pipe trench is if the concrete in a parallel area of the cells is not accessible.

5.7.4.2 Pipes. Historical knowledge indicates that the pipes in the hot pipe trench were flushed when the facility was shut down. To verify this information, the pipes in the hot pipe trench will be non-intrusively examined for the presence of free-standing liquid and a volume estimate will be calculated. Because of ALARA concerns, remote testing may be the only option; if non-destructive technology cannot be deployed, the absence of liquid will not be verified.

Engineering drawings will be used to identify the types of liquid that still may be present. Process knowledge will then be used to estimate the inventory of liquid in each pipe. Sampling the liquid in the pipes is not feasible due to ALARA concerns, so the inventory will be estimated based on volume estimates, process knowledge, and the remote survey of the hot pipe trench.

5.7.5 Galleries and Crane Way

5.7.5.1 Concrete. Because the concrete of the galleries and the crane way has been extensively surveyed, additional sampling for the radiological characterization of these areas is not proposed. There are no historical data for the characterization of non-radiological contamination that may exist in the galleries and the crane way. Therefore, sampling and analysis for non-radiological COPCs associated with these areas will be performed.

The concrete walls and floors within the galleries and the floor of the crane way were surveyed in 1996; the canyon deck was surveyed in 1993 (see Tables 5-4 through 5-9). A comparison of the survey data from the galleries and the crane way to the canyon deck survey data indicate that the general area dose rate in the galleries and the crane way are significantly less than that in the canyon. Based on this comparison, additional radiological sampling of the galleries and the crane way is not proposed; the conclusion is that the radiological inventory of these areas does not significantly contribute to the inventory of the entire 221-U Facility. Once the isotopic and spatial distribution data are available from sampling that will take place in the cells and on the canyon deck, isotopic concentrations will be calculated for the galleries and crane way survey data. Then a DQA will be performed to determine the adequacy of the data from these areas to support the decisions outlined in Section 5.5.

Because no characterization data are available for non-radiological COPCs, biased locations for sampling of the COPCs will take place in order to obtain a worst-case estimate for their concentrations. Because all of the galleries drain to the sumps in the electrical gallery, it is assumed that the sumps are the worst-case location to sample for the galleries. Therefore, sludge/scale material will be collected from each sump in the electrical gallery, provided sufficient material exists for analysis. All of the material will be composited into a single analytical sample that will be analyzed for all of the COPCs identified for each gallery. For the purposes of estimating the COPC inventory of the facility, it will be assumed that the concentrations of COPCs from this datum are uniformly distributed on the surface of the floor and the walls of each gallery; the ceilings of the galleries are assumed to be uncontaminated.

5.7.5.2 Pipes. Currently, there are no historical data to characterize the pipes in the galleries. However, there is process knowledge to identify process and non-process related pipes. This information will be used to divide the sampling of pipes in the galleries into two groups: process and non-process related pipes. Each population will be examined for remaining, free-standing liquid; the liquid will be sampled; and the pipes will be surveyed to get an estimate of dose contribution.

Pipes will be classified as process or non-process based on historical knowledge and engineering drawings. A radiological survey (gamma scan) will be performed along the length of each pipe and, if possible, an intrusive method, such as tapping the potential collection points and traps, will be used to determine whether free-standing liquid is present. If free-standing liquid is found, its volume for each type of piping will be estimated and samples will be collected, if possible. The samples will be composited, based on classification, into a single sample for analysis, resulting in two pipe samples (one from the process piping and one from the non-process piping). These samples will be analyzed for the COPCs associated with the galleries.

5.7.6 Railroad Tunnel

The historical information about the railroad tunnel is limited to engineering drawings, photographs, and video. There is no evidence that personnel have surveyed or otherwise collected data from the tunnel; the rail car bay is located in cell 3. Video and still photos of the rail car are available and show many stained areas. For radionuclides, the proposed sampling design includes performing a survey and assigning concentrations based on the canyon deck samples. The proposed sampling design for the non-radiological chemicals involves collecting samples from biased locations.

The railroad tunnel is being considered a special case of the canyon deck and not the cells because the conceptual model for how it became contaminated is similar to that of the canyon deck. Materials and equipment were remotely unloaded from the rail cars by the crane and lifted to where they were needed. Contamination resulted from equipment leaks and exposure to the air space of the canyon deck and the crane way. Therefore, the radiological data collected from the railroad tunnel will be a gamma scan and general area dose survey. The data from the Phase I sampling on the canyon deck concrete will be used to establish concentration levels from the survey results.

As with the crane way and the galleries, the method for estimating the non-radiological inventory is based on collecting samples from biased locations. Locations will be biased based on staining or rad survey results. The video tape shows several visible areas of staining; therefore, selecting locations based on stains is feasible. The technical team is comfortable applying worst-case contamination to the entire railroad tunnel because it is assumed that, similar to the crane way, the railroad tunnel inventory will not substantially contribute to the overall inventory of the

the railroad tunnel inventory will not substantially contribute to the overall inventory of the facility. Therefore, limiting samples to biased locations is appropriate.

A minimum of 8 concrete chip samples from biased locations will be sampled and composited into 2 samples with 4 grabs in each sample. If 12 biased locations can be identified, then 3 composite samples will be collected. The stained area should be located throughout the length of the railroad tunnel so that an estimate of spatial variability of the stained areas may be calculated, if needed. The number of samples is based on professional judgement and is consistent with the number of samples proposed for the galleries and crane way. Samples will be analyzed for all of the COPCs associated with the canyon deck, which includes all REDOX, PUREX, B Plant, and U Plant process COPCs.

5.7.7 Ventilation Tunnel

The historical information about the railroad tunnel is limited to engineering drawings; there are no personal accounts of anyone ever entering the ventilation tunnel and there is no evidence of any video or survey information. The proposed sampling design for the ventilation tunnel is similar to that of the galleries and crane way: radiological COPCs will be characterized by survey and related to isotopic and depth distribution data from the cells; other COPCs will be characterized by sampling the sediment and/or dust around the baffles on the floor of the tunnel.

5.7.8 Analysis Strategy

The COPCs presented in Table 5-2 were consolidated by the type of analyses required. For example, all nitrate containing compounds will be analyzed for the anion, nitrate (NO_3). Table 5-11 lists the COPC, analytical technique, and the commercial and onsite laboratory detection limit/volume criteria. Both full protocol with a normal turnaround and rapid turnaround with reduced volumes are presented. Detection limits may increase due to the need to use smaller sample volumes due to radioactivity levels.

5.7.9 Quality Control

Quality control (QC) requirements for the field sample collection process and the laboratory analysis are defined below.

QC requirements for the sampling process are as follows.

- One equipment rinsate blank will be collected for each type of sampling equipment used in the field to assess the cleanliness of the sampling equipment and the effectiveness of the sample equipment decontamination process. The equipment blank will be collected using ASTM Type II water passed through the decontaminated sampling equipment before use.

The rinsate blank will be analyzed for the same radionuclide and chemical analytes as actual samples collected during use of the equipment.

- One duplicate sample, or a minimum of one field duplicate per every 20 samples of the same matrix, will be collected. Field duplicates are two samples produced from the same material and collected in the same location or from the same equipment. Field duplicates provide information concerning the homogeneity of the matrix, and an evaluation of the precision of the sampling and analysis process.

QC requirements for the analytical laboratory are as follows.

- One method blank for every 20 samples, analytical batch, or sample delivery group (whichever is most frequent), will be used to monitor contamination resulting from the sample preparation process for each analytical method criterion.

- One laboratory control sample or blank spike will be performed for every batch of samples for each analytical method criterion to monitor the effectiveness of the sample preparation process. The results from the analysis are used to assess laboratory performance.

- A matrix spike sample will be prepared and analyzed for each 20 samples of the same matrix or sample preparation batch, whichever is most frequent. The matrix spike results are a measure of the accuracy of the analytes of interest measured in the sample matrix.

- Laboratory duplicates or matrix spike duplicates will be used to assess precision and will be analyzed at the same frequency as the matrix spikes.

5.7.10 Archive Samples

Provided volume allows, a sufficient volume of liquid and sediment will be kept in an archive until data have been returned and have been found to meet criteria. The archived sample will be a subset of the homogenized material sent to the laboratory.

5.7.11 Data Validation

Level C data validation has been selected per procedures WHC 1993a and 1993b for commercial laboratory sample analysis results. A validation performed in a comparable manner to Level C will be performed on onsite laboratory analyses. This allows the review of all QC data, transcription error verification, and holding time review. This level is the middle validation level and does not require review of raw data and recalculation of data. Should problems arise from the Level C review, the project reserves the option of recalculation and review of raw data.

5.7.12 Data Quality Assessment

Data assessment is performed after data validation of the survey and laboratory analyses. The following steps are taken in data assessment.

1. Review the project DQOs. This includes the variance, decision levels based on ERDF WAC and any groundwater protection/risk levels.

2. Examine the distribution of data. The distribution should be examined both spatially on a map of the structure or area of soil being evaluated, and examined for numerical distribution. An assessment whether the distribution is normal or skewed should be made.

3. Examine the data for outliers for anomalous values. This includes both statistical outliers, anomalous values, results that are above the decision level, and results that are two or more times greater than the decision level. Any anomalous values should be validated and closely examined to assess potential reasons for the anomaly. Assess any data point that is above the decision levels.

4. Determine whether the data are consistent with the conceptual ideas presented in the DQO. Compare the statistical results to other surveys and to other areas of the facility that use the same model. If the conceptual model differs from the data, the decision makers and technical staff must determine the consequences of using a different conceptual model.

5. Use the Phase I data from the canyon deck to determine the isotopic distribution of radionuclides in other areas of the facility. Compare COPCs to the appropriate action levels to determine whether a sufficient number of samples have been collected.

5.7.13 Summary

Table 5-11 summarizes the COPCs and analytical techniques. Table 5-12 summarizes the sampling design and survey locations.

Table 5-11. Analytical Techniques and Detection Limits

Contaminant of Concern (COC)	Analytical Callout	Analytical Technique	Commercial Laboratory				Onsite Laboratory			
			Detection Limits(1)		Volume Requirements		Detection Limit		Volume Requirements	
			Solid(2)	Liquid(2)	Solid(3)	Liquid(3)	Solid(2)	Liquid(2)	Solid(3)	Liquid(3)
Pu-238, Pu-239/240	Pu Isotopic	Alpha Energy Analysis	1 20	1 20	25 4	600 50	20000	200	2	10
Am-241	Am/Cm Isotopic	Alpha Energy Analysis	1 20	1 20	25 4	600 50	20000	200	2	10
Np-237	Np-237	Alpha Energy Analysis	1 20	1 20	25 4	600 50	20000	200	2	10
U-234, U-235, U-238	U Isotopic	Alpha Energy Analysis	1 20	1 20	25 4	600 50	NA	NA	NA	NA
U-234, U-235, U-238	U Isotopic	ICP/MS(5)	NA	NA	NA	NA	0.5	5	2	10
Th-232	Th-isotopic	Alpha Energy Analysis	1 20	1 20	25 4	600 50	NA	NA	NA	NA
Th-232	Th-isotopic	ICP/MS(5)	NA	NA	NA	NA	1	10	2	10
Co-60	GEA	Gamma Energy Analysis	0.1 1	15 100	1500 50	1500 50	10000	100	2	25
Cs-137	GEA	Gamma Energy Analysis	0.1 1	25 100	above	above	10000	100	above	above
Eu-152	GEA	Gamma Energy Analysis	0.1 1	50 400	above	above	30000	300	above	above
Eu-154	GEA	Gamma Energy Analysis	0.1 1	50 400	above	above	30000	300	above	above
Sr-90	Total Radioactive Sr	Beta Counting	1 5	2 10	18 3	3000 250	5000	50	2	10
Gross Alpha	Gross Alpha	Proportional Counting	10 25	3 7	2 .5	600 150	10000	100	2	10
Gross Beta	Gross Beta	Proportional Counting	15 30	4 8	above	above	30000	300	above	above
Al(NO3)3, NH4NO3, NaNO3, HNO3	Anions - Nitrate	Ion Chrom. - EPA300.0	0.1 5	10 50	40 5	300 50	NA	10000	NA	10
NaNO2	Anions - Nitrite	Ion Chrom. - EPA300.0	0.1 5	10 50	above	above	NA	10000	NA	above
H2SO4, Na2SO4, Fe(NH4)2(SO4)2	Anions - Sulfate	Ion Chrom. - EPA300.0	2 10	150 700	above	above	NA	15000	NA	above
NH4F	Anions - Fluoride	Ion Chrom. - EPA300.0	0.2 1	15 70	above	above	NA	2000	NA	above
H3PO4	Anions - Phosphate	Ion Chrom. - EPA300.0	2 10	150 700	above	above	NA	15000	NA	above
Acids	pH	Electrode/paper	0.1 0.1	0.1 0.1	10 3	100 25	0.1 0.1	0.1 0.1	1	25
Hexone	Volatile Organic	GC/MS SW-846 - 8260	.002 .002	1 1	20 5	120 40	NA	NA	NA	NA
Tributyl Phosphate	Semivolatile Organic	GC/MS SW-846 - 8270	0.5 0.5	50 50	120 15	2000 250	NA	NA	NA	NA
Kerosene, Normal Paraffin Hydrocarbon	Kerosene Range TPH	GC SW-846 - 8015	5 5	50 50	20 5	120 40	NA	NA	NA	NA
PCBs	PCBs	GC SW-846 - 8080	0.05 10	0.5 100	120 1	2000 20	NA	NA	NA	NA
Sodium Dichromate	Total Cr	ICP SW846 - 6010	0.5 5	3 20	15 2	500 150	10	50	4	25
Lead Based Paint, Bulk Lead	Total Pb	ICP SW846 - 6010	20 40	250 500	15 2	500 150	100	400	4	25
	Total Pb	GFAA SW846 - 7421	0.4 0.4	2 2	15 2	500 150	NA	NA	NA	NA
	TCLP - Pb	SW846 - 1311/6010	Extract(4)	250 500	300 25	above	Extract(4)	400	10	above
Asbestos	Asbestos	Microscopy	NA	NA	NA	NA	<1%	<1%	1	1

[1]First value is for "Full Protocol", second value is for Rapid Turnaround or Reduced Volume analysis. Full Protocol detection limits require larger volume shown. Detection limits are based on optimal conditions. Sample specific matrix effects or interferences may raise the values shown.

[2]Values in pCi/g or mg/Kg for solids and pCi/L or ug/L for liquids.

[3]Values in g for solids or ml for liquids. Radionuclide analyses and metals analyses volumes maybe combined to reduce total volume needed.

[4]TCLP values are reported as liquid extract concentrations for solid samples and bulk liquid concentrations for liquid samples per the liquid detection limits.

[5]ICP/MS detection limits are expressed in mg/Kg for solids and ug/L for liquids.

Table 5-12. Sampling Design Summary (Page 1 of 2)

Area	Matrix	Summary of Sampling Design
Canyon deck	concrete	Phase 1 • stratify (walkway, open areas w/o equipment, next to equipment) • collect 9 shallow samples Perform DQA Phase 2 (if necessary)
	equipment	• categorize by type (tank, centrifuge, etc.) • non-destructive examination (NDE), if possible • document liquid level • document oil level if present • collect 2 samples of liquid/sludge per category • rad survey 3 pieces per category
Cells	concrete	• divide cells by process • rad survey for dose and gamma • collect minimum of 2 (6 to 8 in.) cores/process • assess depth of radiological contamination • see Section 5.7.2.1 for contingencies
Cells (cont.)	equipment	• divide cells by process • record inventory • categorize equipment into process, "non-process" • NDE if possible • document liquid level • document oil level if present • collect oil if associated with electrical equipment • collect minimum of 1 sample of liquid/sludge per process • collect sample from non-process equipment if similar type of equipment was not sampled on canyon deck • collect 1 sample from tank 5-6, cell 10
Pipe drain	drain in cell 10, exposed to all process liquid	• video tape for structural integrity • collect scale/sludge sample for isotopic distribution • if no scale/sludge, perform gamma scan and compare to cell 10 gamma scan
Hot pipe trench	concrete	• categorize by same processes as cells • no samples, unless no concrete from cell of same process is accessible • calculate inventory based on results from cell from same process.
	pipes	• NDE • estimate liquid and rad inventory based on drawings and cell information from the same process

Table 5-12. Sampling Design Summary (Page 2 of 2)

Area	Matrix	Summary of Sampling Design
Galleries and crane way	concrete	• collect sludge/scale from sumps in electrical galleries • analyze for chemical (non-radiological) only • use current survey data and isotopic distribution from cells to assess total radiological inventory
	pipes	• categorize into process and non-process pipes • examine for free-standing liquid using NDE • survey for dose • collect liquid if sufficient volume exists
Railroad tunnel	concrete	• collect samples from stained areas for non-radiological COPCs; collect minimum of 8 locations, composite to 2 samples or collect from 12 locations and composite to 3 samples. Collect from stained areas throughout length of tunnel. • use survey data with isotopic distribution from concrete samples on canyon deck to estimate isotopic distribution.
Ventilation tunnel	concrete	• video of tunnel • collect dust/scale from near baffles • analyze for chemical (non-radiological) only • use current survey data and isotopic distribution from cells to assess total radiological inventory

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6.0 DATA QUALITY OBJECTIVES PROCESS-STRUCTURAL INTEGRITY

The purpose of this section is to present a strategy for structural evaluations and define associated information needs required to support an endpoint decision for entombment of the 221-U Building in the 200 Area on the Hanford Site. A structural integrity evaluation is primarily needed for the entombment disposition alternatives. Codes, regulations, specifications, DOE orders, and other similar types of standards mentioned in this section are intended to assist in the conduct of structural assessments, and are not to be considered as compliance design standards at this time.

A generalized process is recommended for building structural evaluations based on ASCE 11-90, "Guidelines for Structural Condition Assessment of Existing Buildings." This process identifies the type of information needed for a condition assessment. Within the context of this process for structural condition assessment, the DQO process followed in Section 5.0 has been used to develop a presentation identifying how much of the information we now have, currently available information sources, and a preliminary estimate of additional information that will be needed and potential sources.

6.1 DATA QUALITY OBJECTIVE STEP 1: PROBLEM STATEMENT

A complete structural assessment has not been previously performed for disposition evaluation. The structural integrity for the purposes of long-term disposition is not known.

6.2 DATA QUALITY OBJECTIVE STEP 2: DECISION STATEMENT(S)

The purpose of this step is to identify the key decisions that will be made regarding the nature, timing, and location of samples to be collected.

6.2.1 Structural Integrity of Building

6.2.1.1 Principal Study Question. Does the 221-U Canyon Building have the structural capacity to hold material proposed for placement under alternatives 3, 4, and 5 in the FS? (DOE-RL 1997.)

6.2.1.2 Alternative Actions.

- Structural analysis of the building determines that there is sufficient loading capacity to place the proposed material within the facility; alternatives 3, 4, and 5 of the FS remain viable alternatives.

- Structural analysis determines that the building cannot withstand the loads from the proposed placement of material without unacceptable consequences (e.g., structural failure, concern for worker health and safety, etc.); alternatives 3, 4, and 5 of the FS are eliminated as alternatives.

6.2.1.3 Decision Statement. Determine the load capacity of the 221-U Facility against the requirements for placement of material as proposed in alternatives 3, 4, and 5 of the FS.

6.2.2 Leach Rate

6.2.2.1 Principal Study Question. Is there the potential for contaminants of concern to leach from the 221-U Facility to groundwater at levels that exceed regulatory criteria?

6.2.2.2 Alternative Actions.

- COPCs within the facility are presently leaching or have the potential to leach to groundwater at levels that exceed regulatory criteria. This material/equipment containing these COPCs will be removed or stabilized before proceeding with alternatives 2 through 6.

- COPCs within materials proposed for placement in or around the facility have the potential for leaching to groundwater at levels that exceed regulatory criteria. These contaminants would be removed or stabilized before proceeding with alternatives 3 or 4.

- COPCs presently or have the potential to leach from the facility but at levels that are not anticipated to exceed regulatory criteria. Incorporate a monitoring program for the COPCs into the implementation program for alternatives 2 through 6 along with a contingency plan if levels should exceed the regulatory threshold(s).

- There is no potential for COPCs to leach from the facility at levels that exceed regulatory criteria.

6.2.2.3 Decision Statement. Determine whether there is potential for COPCs to leach from materials presently located within the 221-U Facility or wastes proposed for placement in or around the facility.

6.2.3 Regulatory Equivalence of Cement

6.2.3.1 Principal Study Question. Does the cement structure of the 221-U Facility provide a level of protection to groundwater equivalent to the liner requirements for a land disposal facility?

6.2.3.2 Alternative Actions.

- Regulatory criteria for a liner are not imposed on the facility for any of the entombment alternatives; no further consideration of this issue is required.

- Liner requirements are established as applicable for the entombment alternatives; the concrete of the facility is shown to be the functional equivalent of a liner and no further action is required for this issue.

- Liner requirements are established as applicable for the entombment alternatives; the concrete is not accepted as functionally equivalent to a liner. Determine an approach to retrofit a liner to the facility or eliminate the entombment alternatives.

6.2.3.3 Decision Statement. Determine liner requirements for the entombment alternatives and the functional ability of the concrete as a liner.

6.3 BACKGROUND

The 221-U Building is one of many buildings built in early 1943 through 1945 as part of the Hanford Engineer Works. Documentation of the construction process is available in a report *DuPont Construction History of the Hanford Engineer Works 1943-1945*, (DuPont 1945). Much of the information of interest is reported in Volume 3, pp 800 - 950.

The process canyons, 221-T/U/B, are sister plants, built using the same sets of drawings with modifications for differences in final mission. Common specifications were used for all three plants. They were built in a series with interleaved construction schedules. Concrete forms for the cells were shared among the plants as well as a rolling steel form used for placing the concrete roofs of the buildings. The schedule for the construction of the lower process cell structures for these buildings was:

Building	Date Started	Date Completed
221-T	05-10-44	09-01-44
221-U	08-24-44	11-22-44
221-B	10-30-44	01-24-45

As shown by this schedule, when the lower cell structure of 221-T was completed, the crews moved on to start the lower cell structure of 221-U. A similar relationship is seen for the 221-B plant lower cell structure. At the time of their construction, the 221 process buildings were among the largest close-tolerance concrete structures ever attempted. The upper portions of the canyons were completed after the outer envelope of the building was brought up to the elevation of the crane rails.

These facilities were constructed under one contract by the same crews in a time-phased schedule designed to provide product from the chemical process plant sooner. Thus, the buildings are physically separated, but were constructed as one project. Based on the history reported in the construction history, extrapolation of construction material properties from in situ measurements at B Plant to U Plant is reasonable.

The construction history includes other information that is applicable to current and proposed structural evaluations including:

- boring logs below the 221-U foundations,
- plate bearing test data taken before construction of building 221-U,
- discussions on aggregate barrow pits,
- discussions of available concrete mixing plants and scheduled use, and
- specification changes including the material for the chemical sewer drain pipe.

Historical construction information in combination with more recent structural analyses, material investigations, and soil investigations can be used to make preliminary structural evaluations of the adequacy of the 221-U Facility for planned entombment activities. Results from additional efforts to secure site-specific material properties information, conduct of enhanced existing condition assessments, and additional structural evaluations will be used to confirm the preliminary structural evaluations and reduce residual uncertainties.

6.4 THE STRUCTURAL EVALUATION PROCESS

The generalized process for structural assessments of existing buildings and the steps in this iterative process are shown in Figure 6-1.

6.5 DATA QUALITY OBJECTIVE STEP 3: INPUTS

Two inputs are needed to support the structural key decisions.

1. Conduct a structural condition assessment for the 221-U Building to evaluate current capacities of the building structural systems safely to resist loadings during and after entombment operations.

2. Conduct a structural condition assessment for the 221-U Building to evaluate the flow paths into and out of the canyon during and after entombment.

These inputs are the basis for the activities identified in the structural DQO tables. Supporting activities are based on the general evaluation process shown in Figure 6-1. General program objectives for structural sampling and studies are presented in Tables 6-1 and 6-2.

6.6 DATA QUALITY OBJECTIVE STEP 4: BOUNDARY

The boundary is the entire facility and the concrete-covered 0.61-m (2-ft) diameter pipe that is underneath the building and runs the length of the facility.

6.7 DATA QUALITY OBJECTIVE STEP 5: DECISION RULES

The decision logic is included in Figure 5-1. The structural evaluation does not lend itself to establishing decision limits; therefore, decision limits are not included in this document.

6.8 DATA QUALITY OBJECTIVE STEP 6: SPECIFY TOLERANCE LIMITS ON DECISION ERRORS

The structural assessment does not lend itself to calculations of variance. Therefore, assessment of decision errors does not apply.

6.9 STRATEGY FOR OBTAINING STRUCTURAL INFORMATION

This section is analogous to the optimization of the design step in the DQO process. This section is divided into subjects consistent with the flowchart shown in Figure 6-1 for the structural existing condition evaluation process. Discussion is furnished identifying overall strategies, required plan development, and engineering standards applicable to the individual information acquisition activities. Key assumptions are identified for several of these items.

6.9.1 Available Document Review

A subset of the U-Plant drawings was reproduced to support this activity. Reproductions from the Hanford Site Record System aperture cards are of limited legibility. For instance, it is not clear if all required rebar call outs can be read on these drawings. No previous effort was made to research the facility construction specifications. Some effort will have to be expended to acquire and review a full set of the facility drawings and the specifications if they are available in the engineering files. Because of the fragility of the originals, any decision to reproduce the originals should consider printing several working sets to support future engineering activities related to facility disposition, whether it will be by entombment or dismantlement. Some drawings that are finally assembled will be as-built as necessary to support the structural condition assessments. Perhaps the operating organizations can be requested to conduct an initial pass on marking up as-builts before the structural inspection team conducts proposed new walkdowns.

6.9.2 Site Inspection for Structural Condition

Partial walkdowns have been conducted of both U Plant (Baxter 1991) and B Plant (Wagenblast et al. 1988; Winkel et al. 1989). Walkdown plans will have to be developed identifying the walkdown objectives relating to both structural current condition assessment as well as flow path assessments. Access plans for remote closed-circuit television (CCTV) inspections of the wind tunnel and the 60.96-cm (24-in.) process cell sewer should be integrated into the overall observational condition assessment.

Past B-Plant assessments included subcontract work by Muenow and Associates (Winkel et al. 1989, Chapter 4, Appendix A). Pulse echo inspection and ground penetrating radar were used to establish in situ estimates for concrete strength, modules, and rebar locations. Inconsistencies in rebar location between the non-destructive examination (NDE) testing and the drawings led to in situ excavation of roof concrete to verify rebar locations. The drawings were accurate. Additional in situ investigations by Cruz (1992) also demonstrated that the drawings were accurate.

Prior walkdowns were conducted using the guidance in ACI 201.1R-84 "Guide for Making a Condition Survey of Concrete in Service" for visual inspection of existing concrete structures; similar rules should be used for future walkdown assessments. Additional guidance is now available in ACI 364.1R-94 "Guide for Evaluation of Concrete Structures Prior to Rehabilitation," a more recent publication that parallels information in ASCE 11-90 and provides additional detail for evaluations of existing concrete structures.

It is a common problem during walkdowns to encounter plant areas with poor illumination and some detail at a higher elevation of interest. Walkdown equipment should include high-power, hand-held flood lights, and adequate telephoto lenses on cameras and video cassette recorders (VCRs) to record anticipated information adequately. Tape recorders can usefully speed up recording of the field observations.

A preliminary suggestion for flow path observations is to check for deviations from the dimensions shown on the as-built drawings that would contribute to enhanced flow in to and out of the canyon. For example, evidence of opening or gapping on the expansion joints between the canyon segments, or extensive cracking at the corners of door openings or pipe chases that produce paths running through the entire wall thickness. The required observations should be developed and coordinated with the groundwater modeling team that will be developing contaminant transport models. It is highly likely that bounding estimates will be used for flow path estimates, rather than actual test data.

6.9.3 Structural Analysis to Establish Load Capacities

6.9.3.1 Loading and Performance Criteria. Current concrete building codes will be used to evaluate structural adequacy of the U-Plant structural systems. Design criteria applicable during entombment operations are found in ACI 318. Current natural phenomena loadings are available for the Hanford Site according to DOE Order 420.1, which is scheduled to become incorporated in the *Code of Federal Regulations* (CFR) through rulemaking later this year. Federal regulation. 10 CFR 61, applies to the entombed facility after it has been closed. Additional load cases may have to be developed and evaluated for construction sequences associated with entombment operations, with respect to limiting differential loadings between the spaces inside the canyon and the space surrounding the canyon due to backfill activities. Large backfill loadings were not part of the original design, and will have to be investigated in detail.

6.9.3.2 Primary Structural Systems. Prior B-Plant studies (Wagenblast et al. 1988; Winkel et al. 1989; Scott and Moody 1996) have identified some primary structural systems for lateral loadings, but have not addressed a complete set of these systems for both gravity and lateral loads. An additional engineering study will be required to complete the identification of the primary structural systems for U Plant. Areas needing additional development include seismic and wind lateral loadings parallel to the long axis of the canyon structures, and the gravity load systems for the main process deck, galleries, and the roof. Detailed differences in layout between U Plant and the sister plants will have to be identified and addressed. This study will have applicability later when the entombment option is considered for both B and T Plants.

6.9.3.3 Establish the As-built Strength of U-Plant Materials. A key assumption is that drawings for U Plant indicate that the original concrete design strength specified was 2,500 psi. Cruz (1992) developed a test plan for obtaining 12 core samples from B-Plant wall areas in 1992 and conducting compressive strength tests. The average compressive strength for these tests was 4,180 psi, which greatly exceeds the original design strength of 2,500 psi. No additional efforts will be made to justify higher in situ strengths.

T/U/B Plants were built during wartime shortages of steel (including rebar). All of the structural members in these facilities are highly under reinforced. The strength of these members does not depend so much on concrete strength, as it does on the availability of the original rebar steel at the design location in good condition. Several efforts have been made to evaluate the in situ location and condition of rebar at B Plant (Wagenblast et al. 1988; Cruz 1992). All efforts to date have shown that the drawings are accurate, and that the rebar is in excellent condition.

Two in situ assessments are recommended for evaluation of U-Plant concrete member strength. Cruz (1992) conducted an investigation with 12 7.62-cm (3-in.) diameter cores taken from 4 elevations in one segment of B Plant. Three trenches were excavated to obtain rebar samples for condition assessment and tensile samples. Operational safety will be primarily influenced by the concrete structures located above the canyon working deck. Therefore, it is suggested that a total of 12 cores be taken from 4 segments in U Plant at elevations above the canyon working deck. This will allow estimation of a mean and standard deviation for concrete strength in each segment, and a segment-to-segment comparison within U Plant. The results can also be compared to Cruz (1992) to establish the degree of consistency in this parameter from U Plant to B Plant. Larger 12.7-cm (5-in.) diameter cores will be required because of the aggregate size. Cruz found that two out of 12 core samples contained aggregate particles that were too large for testing conducted on 7.62-cm (3-in.) diameter cores. Hanford Site construction history mentions the batch plant large screen size as 6.35 cm (2.5 in.). Compressive strength cores should have a minimum diameter equal to at least twice the diameter of the largest aggregate; therefore, the future cores will be 12.7 cm (5 in.) diameter at a minimum.

Trenches should be excavated in locations proximate to each of these new coring locations to take a minimum of 3 rebar samples for each core because the facility strength depends primarily on the rebar condition, location, and strength. An alternative that should be considered during development of the test plan is the use of NDE methods to assess rebar locations for comparison to the drawings at most locations in lieu of only conducting concrete excavation to obtain rebar samples at most locations. Compressive strength testing of this core population and tensile testing of the rebar should be sufficient to confirm the current strength of the U-Plant canyon primary structural materials.

Concerns for the long-term integrity of Hanford Site concretes have recently arisen in reviews of the Canister Storage Building project. The essence of these concerns is that the groundwater chemistry is sufficiently aggressive to degrade concrete placed on site in a relatively short period. This is also a 10 CFR 61 concern for long-term storage of Class C and below waste. Excavations will have to be made at both ends of U Plant down to elevations of the process cell sewer plugs to allow access for remote inspection of the 60.97 cm (24 in.) process cell sewer (per previous discussion of walkdowns). It is proposed that 12 concrete cores be obtained from the end wall of U Plant at varying elevations down to the elevation of the plugs for the process sewers. One-half of these cores should be used for concrete strength testing. The other half of the cores are to be reserved for petrographic examination to assess the long-term effect of Hanford Site groundwater on the integrity of concrete with time as a function of depth from the surface into the concrete members. Cruz (1992) contains all of the applicable testing standards necessary to conduct both of the coring programs and the rebar testing. Developing criteria for the petrographic examinations of concrete will be necessary relative to durability under contact with groundwater.

Long-term effects of radiation on concrete integrity have come up as a concern in the DQO process. Radiation effects on concrete have been studied for many years as the nuclear industry has developed. An instantaneous radiation dose to a material is generally discussed in terms of the "flux"; an instantaneous radiation dose per second of time. Long-term cumulative effects are generally discussed in terms of the time-integrated total dose called fluence. This question came up with respect to previous evaluations of the Hanford double-shell tanks (DSTs). It was not a major concern for evaluations of the DSTs, but it can be a concern for evaluation of concrete immediately surrounding the core of operating reactors. Design requirements for the Fast Flux Test Facility (FFTF) considered this issue; however, it is not an important concern for evaluation of U-Plant structures because the exposures (cumulative fluence) are below levels of concern by orders of magnitude.

6.9.3.4 Structural Analyses to Establish Load Capacities. These analyses will have to address two major concerns for structural adequacy: the soils below U Plant and the concrete members of the building itself.

6.9.3.5 Soils. Original siting information contained in DuPont (1945) provides both characterization data for the strata below the U-Plant foundations and "New York City" plate bearing test data for the foundation excavations. Plate bearing test data can be used to back out an angle of internal friction for the foundation sands and gravels. More recent geotechnical investigations by Dames & Moore (1989) and Shannon and Wilson (1994) provide sufficient information to corroborate the original estimate for foundation bearing capacity determinations.

More recent efforts to evaluate the deformability of sands and gravels below the 241-AX tank farm (Baxter and Moore 1997) provide adequate information to establish settlement limits.

6.9.3.6 Existing Member Capacities. Concerns for member capacities revolve around operational safety issues related to floor and roof capacities for gravity loading during entombment operations. A second concern is the ability of the facility superstructure (areas above the canyon operating deck) to resist natural phenomena loadings such as wind and earthquake.

Since 1943, gravity load evaluations have been focused toward evaluating concrete design code changes on the capacities of the operating gallery floors and the canyon roof to resist gravity loads during and after entombment. The most significant changes have been in development length requirements for rebar and allowable shear stresses for one-way slab design. This will mean derating the floors and roof against the original gravity load intensities. Members of the DQO team noted that the original floor load ratings are still on the walls in U Plant, 113.5 kg (250 lb) per square foot. Derating will result in a number that will support entombment.

Three reasonably current state-of-the-art evaluations (Wagenblast et al. [1988], Winkel et al. [1989] and LATA [1989]), have been made for lateral load resistance of B-Plant transverse to the long axis of the canyon. An additional evaluation has been made for the B-Plant end wall next to the Waste Encapsulation and Storage Facility (WESF) by Scott and Moody (1996). All of the lateral load evaluations are limited, in that they do not address the question of load combinations for lateral loads in both N-S and E-W directions. It is suggested that this be approached through a linear combination of demand/capacity for both directions with a summation equal to, or less than 1.0. It is anticipated that the U Plant can be shown to have lateral load capacities adequate to assure worker safety during entombment.

6.9.3.7 Structural Evaluation, Summary Report. This report should be prepared in several phases consistent with the overall program plan for entombment of the U-Plant Facility. An initial version should be prepared in the short term consistent with the DQO process. Updates should be issued as each of the major structural issues are dispositioned, whether structural capacity for safety, or flow paths. Utilizing a change control process for these changes will be useful rather than having to reissue entire documents.

Activities to develop backfill performance requirements and specifications for materials and construction sequences for entombment of U Plant should be planned, but are outside the scope of this DQO process. These considerations should be addressed in the overall program plan for entombment of U Plant.

Figure 6-1. General Structural Assessment and Evaluation Procedure

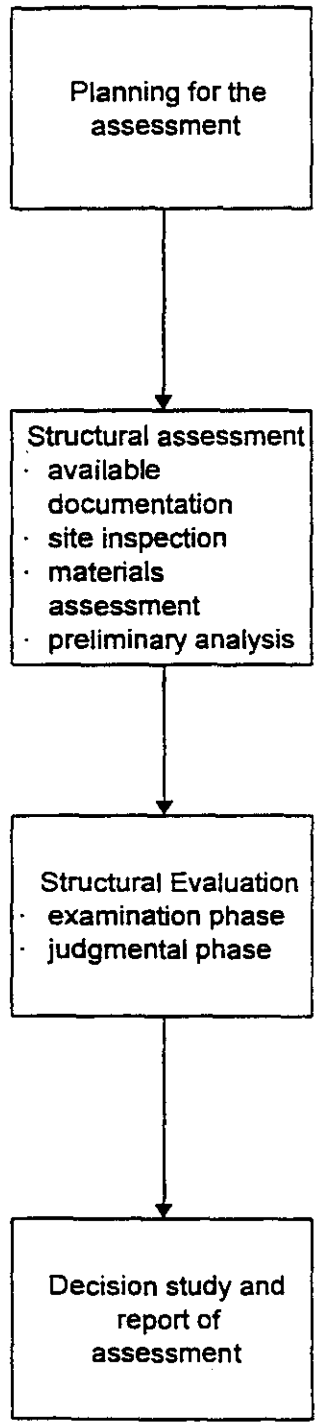

Table 6-1. Endpoint: Entombment
1.0 Structural Capacities (Page 1 of 3)

Information Needed	What is Available?	Where is the Source?	What Additional Information is Needed?
Structural Assessment			
1.1 Available documents review			
1.1.1 Civil/structural drawings	Structural drawings including changes	Hanford Site record system	Additional walkdown to establish current as-built condition
1.1.2 Construction specifications	Original facility construction specifications	Hanford Site record system	Locate and review
1.1.3 Original design criteria	Subset of drawings, some illegible	Structural drawings in Hanford Site record system	Obtain legible set of copies from originals and review
1.1.4 Soil investigations	Soil boring and plate bearing test data from the original construction. Additional soil reports for more recent projects.	• Hanford Site record system. • DuPont (1945, Vol. III, pp 815-817) • Dames & Moore (1989) • Shannon & Wilson (1994) • Baxter and Moore (1997)	Available information is adequate to support a preliminary structural assessment and evaluation for bearing capacities and projected settlements during and after entombment.
1.1.5 Structural design calculations	Not available	Unknown	Perform structural calculations to assure safety during and after entombment operations
1.1.6 Existing reports review	Walkdown reports for U Plant and B Plant seismic analyses	• Baxter (1991) • Wagenblast et al. (1988) • Winkel et al. (1989)	Have in file
1.2 Site inspection for structural condition			
1.2.1 Confirm that drawings as representative of the building as-built condition.	U-Plant walkdown for structural condition only, B-Plant walkdowns and seismic analyses	• Baxter (1991) • Wagenblast et al. (1988) • Winkel et al. (1989)	As a minimum, visual inspection of the currently unexamined spaces within U Plant will be required
1.2.2 Assess current condition of the building for deterioration of materials, evidence of foundation settlements, intersegment offsets, and structural member or connection distress	U-Plant walkdown for structural condition only, B-Plant walkdowns and seismic analyses	• Baxter (1991) • Wagenblast et al. (1988) • Winkel et al. (1989)	Walkdowns have been completed for both U Plant and B Plant. An additional walkdown should be conducted to compare the two facilities.
1.3 Structural analysis to establish load capacities			
1.3.1 Establish loading and performance criteria	Use current building codes and current Hanford Site natural phenomena loading requirements	• ASCE 11-90 • DOE Order 420.1 • 10 CFR 61	None required

Table 6-1. Endpoint: Entombment
1.0 Structural Capacities (Page 2 of 3)

Information Needed	What is Available?	Where is the Source?	What Additional Information is Needed?
1.3.2 Primary structural systems. Identify the primary vertical and later force paths that transfer loads to the foundations. Identify the members and connections in each of these systems and paths, and the physical properties and details for each of these structural elements.	Partially complete with current inventory of seismic studies for B Plant.	• Wagenblast et al. (1988) • Winkel et al. (1989) • Scott and Moody (1996)	An engineering study will be performed to complete the identification of the primary vertical and horizontal load resisting structural systems. the force paths, and the primary resisting members and connections.
1.3.3 Establish the as-built strength of the materials used for the structural load carrying systems	Existing studies of B Plant provide strength information that can be extrapolated to U Plant	• Wagenblast et al. (1988) • Winkel et al. (1989) • Cruz (1992)	Existing data can be extrapolated to U Plant, a confirmatory coring and testing plan will be developed and completed to verify the preliminary extrapolation.
1.3.4 Member analyses. Analyze critical members and their connections to determine resistant capacities and compare these capacities to demand capacities for the loading conditions expected during entombment using current design criteria. Use capacity reduction factors to account for different detailing practices allowed by original design codes.	Lateral load system evaluations are available for B Plant. These evaluations have not considered detailing design changes with code evolution. Gravity load analyses are not available. Additional load cases will have to be considered representing operations during and after entombment	• Wagenblast et al. (1988) • Winkel et al. (1989) • Scott and Moody (1996)	A study will be conducted to assess structural demands on structural members for comparison to their capacities based on current condition. A subset is complete, more work is needed to address all loadings to be encountered during and after entombment.

Table 6-1. Endpoint: Entombment
1.0 Structural Capacities (Page 3 of 3)

Information Needed	What is Available?	Where is the Source?	What Additional Information is Needed?
1.4 Structural evaluation, Summary Report			
Integrate the information and data regarding the existing building with the results from analyses of critical components and connections to determine the existing structural condition of the building. Provide an evaluation of the actual/ required capacity for the important members for all load cases to be encountered during and after entombment. If the building meets the performance criteria, the structural condition is adequate. If the structural condition is inadequate, conduct an upgrade study to evaluate cost-benefits; or a recommendation will be made to eliminate the entombment option.	See sections 1.1 through 1.3 for available information.	See sections 1.1 through 1.3 for available information.	Structural Feasibility Study is required to provide additional information in the following areas: • Required additional walkdowns and remote inspections for facility areas not accessible by radiation worker qualified personnel. • Additional structural core testing and NDE/NDT inspections required at U Plant. • Engineering study to complete the facility lateral load analyses and establish vertical load limits for the floors and roof during and after entombment. • Engineering study to identify structural elements requiring backfitting prior to entombment. • Engineering study to develop backfill/grout specifications, backfill procedures, and construction sequences for the entombment operations.
1.5 Cost-Impact Study			
Conduct a cost-impact study to estimate the structural costs associated with safely implementing the entombment alternative. Integrate this study with the other cost factors being developed to support the entombment option.	Interface to overall program.	Interface to overall program.	Refinement of ROM costs estimated in the *Phase I Feasibility Study for the Canyon Disposition Initiative (221-U Facility)* (DOE-RL 1997).

Table 6-2. Endpoint: Entombment
2.0 Flow Paths (Page 1 of 2)

Information Needed	What is Available?	Where is the Source?	What Additional Information is Needed?
Flow Paths Assessment			
2.1 Available document review			
2.1.1 - 2.1.6	Same as 1.1.1 - 1.1.6 in Table 6-1. Focus of review is flowpaths for liquids into and out of the canyon. No work to date.	Same as 1.1.1 - 1.1.6 in Table 6-1.	Interface to groundwater hydrology
2.1.7 Existing reports - flowpath assessments	Remote closed-circuit television (CCTV) inspection of the B-Plant 24 Inch Cell Drain Header (Werry 1990)	Hanford Site Record System	Remote CCTV inspection of the U-Plant 24 Inch Cell Drain Header
2.2 Site inspection - Flow Paths			
2.2.1 Confirm drawings are an accurate representation of all flow paths into and out of U Plant: • access ways; doors, airlocks, penetrations • construction joints, expansion joints, cover block gaps • mechanical and piping penetrations	No work to date. Facility drawings are available in the Hanford Site Record System.	Hanford Site Record System	Walkdowns and remote inspections to establish the as-built configuration of all flow paths.
2.2.2 Assess current conditions of the flow paths for: • building modifications • deterioration of materials • evidence of building settlement • long-term deflections that may influence flow paths	No work to date. Facility drawings are available in the Hanford Site Record System.	Hanford Site Record System	Walkdowns and remote inspections to establish the as-built configuration of all flow paths. Interface to groundwater hydrology
2.3 Structural analysis for evaluation of flow paths and remedial design			
2.3.1 Evaluate concrete bulk properties • permeability • void ratio • density	Open literature	not applicable	Suggest using handbook values for initial groundwater modeling

Table 6-2. Endpoint: Entombment
2.0 Flow Paths (Page 2 of 2)

Information Needed	What is Available?	Where is the Source?	What Additional Information is Needed?
2.3.2 Evaluate fracture flow parameters • aperture • length • tortuosity	Drawings provide initial design configurations.	Hanford Site Record System	Walkdowns conducted under item 2.2.2 will provide information on current condition of each aperture. Interface to groundwater modeling. Will require a joint effort to decide on information needs and required model simplifications.
2.3.3 Design plugs for large scale building apertures to be installed during entombment operations.	No work to date	No work to date	Activity for feasibility study.
2.4 Structural assessment of flow paths			
No work to date.	No work to date	No work to date	

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7.0 LESSONS LEARNED

Evaluating disposition alternatives for the 221-U Facility is a complex and time-consuming task. The DQO Process has helped the project keep its goal in focus and has provided a mechanism for approaching, discussing, and planning for the collection of the integrated information required for this complex problem. The DQO Process has also provided a degree of consistency between the different technical subteams that may have not been possible without it. The DQO Process has also facilitated discussion with the regulators on the project so that time and resources are used most effectively.

Applying DQOs to the structural data needs has provided focus to the data collection needs in an area not typically addressed in the DQO Process. The DQO Process has resulted in emphasis on the structural issues, which were not initially the focus of data collection.

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8.0 COST SAVINGS

Completion of the DQO Process for the 221-U Characterization effort is forecasted to save approximately $5 million. Baseline costs for characterization of the 221-U Facility were estimated at $4.3 million, not including characterization of tanks and equipment in the cells and on the canyon deck (*REDOX and U-Plant Decommissioning Long-Range Plan* [Speer 1992]). Based on the number of samples and the project assumptions specified in Speer (1992), characterization of the tanks and equipment would cost an additional $5 million bringing the total baseline cost to approximately $10 million.

It is estimated that the total cost for characterizing the 221-U Facility, in accordance with the rationale described in this DQO, will be less than $5 million. This estimate includes full characterization of the facility including tanks and equipment. The cost savings is a direct result of the agreements obtained through the DQO Process as specified in Sections 5.0 and 6.0 of this report.

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APPENDIX A

EQUIPMENT LIST

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Table A-1. Equipment List (Page 1 of 5)

Section	U-Plant Equipment in Cell				Comments
	Cell	Equipment #	Equipment Type	Facility	
	35	8-1	Tank	B, T, or U Plant	9 ft by 9 ft tank
	5		Centrifuges	B Plant	3 centrifuges
	7	P-27-3	Pump	B Plant	Repaired
	7	P-28-3	Pump	B Plant	Repaired
	7	1A-12-1	Agitator	B Plant	Repaired
	7	A2-A19-1-1	Agitator	B Plant	Repaired
	7	2A-30-3	Agitator	B Plant	Repaired
	7	2A-A17-1	Agitator	B Plant	Repaired
	11	F-22	Filter	B Plant	For burial
	12	1G-13-2	Centrifuge	B Plant	
	13	1C-27-1	Pulser	B Plant	
	13		Centrifuge	B Plant	Unmodified centrifuge
	16	31-1	Tank	B Plant	For storage
	21		Jumpers	B Plant	18 jumpers need deconned and buried
	22	32-2	Centrifuge	B Plant	
	27		Tank	B Plant	9 ft by 9 ft tank
	29		2- Ti-tube bundles	B Plant	Save for B Plant
	31	32-2	Centrifuge	B Plant	To be deconned and repaired
	31		Centrifuges	B Plant	Unidentified centrifuges, number unknown
	34		Tank	B Plant	9 ft by 9 ft tank
	36	8-1	Tank	B Plant	9 ft by 9 ft tank
	38	12-6	Tank	B Plant	6 ft by 14 ft tank
	38	9-1	Tank	B Plant	9 ft by 9 ft tank
3	6		2-pipe wrench milling saws	B Plant	
5	9	35-1	Repaired tank	B Plant	
9	18		Tank	B Plant	9 ft by 9 ft tank
10	19	13-1	Tank	B Plant	9 ft by 9 ft tank
11	21		Disolver	B Plant	
11	22	SP-5	Tank	B Plant	
15	30	31-1	Tank	B Plant	
16	31		Tank Coil	B Plant	6 ft by 3.5 ft coil made in error
16	31	E-20-3	Condenser	B Plant	Deconned

Table A-1. Equipment List (Page 2 of 5)

Section	U-Plant Equipment in Cell				Comments
	Cell	Equipment #	Equipment Type	Facility	
16	31		Tank	B Plant	8 ft by 14 ft tank
17	34		Centrifuge "A" frame	B Plant	
17	34	J-8	Condenser	B Plant	
17	34		7-Happo shipping casks	B Plant	
18	35		9 ft by 9 ft tank	B Plant	
	7	R-1	Pump	Purex	2 pumps; repaired
	7	GS-1	Pump	PUREX	Repaired
	7	JG4199	Pump	PUREX	No history
	12		Pot dissolver	PUREX	
	16		Jumpers	PUREX	17 thorium jumpers tobe buried
	18	F-8	Tank	PUREX	Needs decon and repaired
	20	B-3	Pot dissolver	PUREX	To be buried
	22	C-3	Dissolver	PUREX	To be buried
	23	C-3	Dissolver	PUREX	To be buried
	24		Crane tool box	PUREX	Stored per PUREX request
	28	F-7	Tank	PUREX	Hot (1R/hr), save for PUREX, possible decon and repair
6	12	A-3	Disolver shipping cradle	PUREX	
8	15	F-14	Tank	PUREX	15
8	15		Tube bundle shipping capsule	PUREX	
8	16		condenser assy., old bolted flange type	PUREX	
11	22		dissolver catch tank yoke	PUREX	
12	24	F-5	Condenser	PUREX	
12	24	G-G3-SO	Centrifuge	PUREX	
15	29	EA-2	Off-gas Heater	PUREX	
15	30	2-G-G-3	Centrifuge	PUREX	
16	31	H-4	Condenser	PUREX	
16	32	2-G-E2, SS764	Centrifuge	PUREX	
17	34	1-PG-G2	Pulser	PUREX	

Table A-1. Equipment List (Page 3 of 5)

Section	U-Plant Equipment in Cell				Comments
	Cell	Equipment #	Equipment Type	Facility	
17	34		Off-gas jumper	PUREX	
	2	D-13	Tank	REDOX	
	2	G-3	Tank	REDOX	
	2	G-3	Concentrator	REDOX	
	2	H-4	Coil	REDOX	
	26	11-V-D-12	Pot	REDOX	
	30	D-10	Pot	REDOX	
	30	F-1	Pot	REDOX	
	30	D-14	Tower	REDOX	
	30	F-2	Tower	REDOX	
	31		2 tube bundles	REDOX	Two- tube bundles stored in capsules
6	12		Tank	REDOX	9 ft by 6 ft tank
8	16		Tube bundle capsule	REDOX	
10	19		Pot dissolver	REDOX	
10	20		Pot tower	REDOX	
12	23		Pot dissolver	REDOX	
12	24		Centrifuge "A" frame	REDOX	
13	25		Silo leaded glass window	REDOX	
13	26	F-2	Pot	REDOX	
3	5		Centrifuge	T Plant	
11	21		5-exhaust ventilators	T Plant	
15	30		Centrifuge "A" frame with tank and bowl	T Plant	
17	33		Centrifuges	T Plant	2 old centrifuges "A" frame with tank and bowl
	6		Tank	U Plant	9 ft by 9 ft tank
	8	4-8	Waste tank	U Plant	Original equipment, jumper installed
	9	5-1	Waste tank	U Plant	Original equipment, jumper installed
	9	5-2	Waste tank	U Plant	Original equipment, jumper installed
	10	5-6	Waste tank	U Plant	Original equipment
	11		Evaporator dunnage	U Plant	
	11	6-4	Tank	U Plant	
	15	E-8-1	Evaporator	U Plant	

Table A-1. Equipment List (Page 4 of 5)

Section	U-Plant Equipment in Cell				Comments
	Cell	Equipment #	Equipment Type	Facility	
	15			U Plant	Original equipment from cells, jumpers removed
	17		Pulse column	U Plant	
	17	7-4	Concentration dunnage	U Plant	
	19			U Plant	Original U-Plant equipment
	24		Tank	U Plant	8 ft by 14 ft tank
	24	11-6-3	Pump	U Plant	
	25		Pumps and agitators	U Plant	Storage rack containing 17 misc. pumps and agitators
	32		Tank	U Plant	9 ft by 9 ft tank
	33	9-H	Tank	U Plant	
	36	9-7	Tank	U Plant	7 ft by 14 ft tank
	37		Tower	U Plant	TBP tower
	40	20-6	Bathtub	U Plant	All original equipment intact
7	13		Condenser	U Plant	Not modified for B Plant
12	24		Concentrator column	U Plant	
13	26		9- pumps/agitators	U Plant	
7	14		Storage Rack	U/B Plant	Pump/agitators removed from U Plant but never modified for B Plant
	4	7-1	Fuel storage rack		
	5		Fuel canisters		19 pairs
	14	A-11-1	Agitator		Needs work
	14	2A-24-1-2	Agitator		Modified
	14	2A-A6-1	Agitator		Modified
	14	P-13-6-1	Pump		For burial
	14	P-4-6-2	Pump		For burial
	14	P-4-6-1	Pump		For burial
	14	P-11-6-3	Pump		For burial
	14	P-18-3	Pump		For burial
	14	P10-7	Pump		For burial
	14	P16-6-2	Pump		For burial
	14	P-14-7-2	Pump		For burial
	14	A-18-3	Agitator		For burial

Table A-1. Equipment List (Page 5 of 5)

Section	U-Plant Equipment in Cell				Comments
	Cell	Equipment #	Equipment Type	Facility	
	14	A-14-2	Agitator		For burial
	14	A-17-3	Agitator		For burial
	19	T-10-4	Concentrator dunnage		
	27				Storage
	35		Jackets		s/s jackets from 9 ft by 9 ft tanks
	39				Unknown
5	10		Yoke		Yoke for handling Stanray cask lid

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APPENDIX B

MEETING MINUTES

**(Global Issues Meeting, June 10, 1997 and
External DQO Meetings June 16, 18, 26, July 17 and 21, 1997)**

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Meeting Minutes

221-U Canyon DQO Global Issues Meeting

June 10, 1997

Attendees:

J. Donnelly-Ecology
P. Innis-EPA
T. Brown-ERC
R. Borisch-BWHC
J. Rugg-BHI
D. Encke-ERC
R. Henckel-BHI
G. Cox-BWHC
J. Sands-DOE
J. Goodenough-DOE-AME
J. Maguire-DOE
L. Oates-EQM
M. Miller-EQM

A meeting on the above subject was held on June 10, 1997 in meeting room 2A-01 at 3350 George Washington Way.

Mitzi Miller opened the meeting with introductions all around and a discussion of the purpose of the DQO process and of the DQO for the 221-U Canyon project in particular, i.e., which project issues require data and which do not. The DQO scoping binder was distributed to those attendees who had not previously received a copy. The purpose of the binder is to provide a common starting point of information for all parties.

Rules of the DQO Participants

As a starting point for the process, the attendees listed ground rules to govern the process:

- No name calling
- Conflict resolution process
  - Political issues will be documented and tabled, as they can not be resolved in this forum
  - Technical issues will be resolved only when the right personnel from the appropriate parties have the opportunity to get involved
- Take time outs when necessary
- Let everyone have their say
- Keep facilitator informed of problems and concerns
- Agree to disagree unless it inhibits adequate data collection

- Bring organizational constraints to the table

Issues

As a first step, the attendees listed significant issues for the 221-U Canyon project. Consensus of the attendees was subsequently used to group the issues according to those that require data and those that do not; the issues are included in an attachment to these minutes, grouped into these two categories.

The current meeting is to identify issues and establish the process. The schedule for the DQO process was discussed in order to establish a time frame for the initial DQO process meetings. The first meeting (DQO #1) will cover the development problem and decision statements. The group was charged with developing their own list of decisions that should be addressed by the DQO. A draft problem/decision statement was distributed to the attendees as guidance (copy attached) - each decision must have an action or a consequence that results from the decision.

Action Item: Each participant to develop list of problems and decisions that affect data collection for next meeting.

At the next meeting (DQO#2), the group will agree on a problem statement, create a table for each decision, identifying the inputs (data and information) and limits associated with the decision. Boundaries will be developed for the decisions as well as decision logic, what triggers an action.

At the subsequent meeting (DQO#3), decision logic will be established along with the level of uncertainty acceptable for each decision.

After meeting number 3, four to five days will be used to work up sample designs and options before reconvening.

Dave Encke provided an overview of the materials provided in the scoping document (binder). It was decided that there is no current need for a summary of the information contained in the binder.

Bob Henckel noted that the HAB had been in touch with a firm that has conducted groundwater modeling for other radionuclide contaminated sites. ERC will be meeting with representatives of this company to evaluate the potential for use of their services on this or other ERC projects.

Pam Innis asked whether there were plans to respond to the issues raised by the HAB to the Feasibility Study. There are no formal plans to do so at this time.

Next Meetings

The first DQO meeting will be held on June 16 at 7:30 am in Building 271 in the 200 West Area to discuss problems and decisions. A limited tour of the 221 facility will be arranged in conjunction with this meeting (cotton clothing - boots required). A video will be shown of the interior of the canyon. The second meeting will be held on June 18 at 7:30 am; location to be determined.

Attachments:

Table 1 - List of Issues needing data and not needing data
List of Issues from Interviews

221-U Canyon DQO - Issues and Objectives

June 10, 1997

The following issues were identified during the 221-U Canyon DQO interviews conducted with DOE, USEPA, Ecology, ERC, and B&W personnel over the period of May 22 to June 5, 1997:

Project Scope

Possible areas of investigation include the following (relevant alternatives are listed in parentheses):

- CERCLA characterization (for both performance and ALARA issues) for facility and contents (1,2,3,4,5,6)
- RCRA characterization (LDR wastes, barrier performance) for contents and facility (3,4,5,6)
- Structural Integrity of facility (2,3,4,5)
- Characterization of potential wastes for emplacement (3,4)
- Characterization of surrounding soils and structures (1,2,3,4,5,6)
- Sampling programs could have one of three potential applications - baseline characterization, closure operations, and/or facility monitoring. The DQO can include one or all of these aspects. Consideration should be given up front to which of these programs are included and the relative cost of limiting or expanding the scope, as appropriate.

Project Boundaries

Characterization units need to be determined to support the definition of radionuclide inventories - e.g., units could be defined as cells, pairs of cells, the entire canyon platform or sections of the platform, etc.

Elimination of one or more of the alternatives identified in the Feasibility Study would help to define the scope of the DQO. The DQO process should establish the sampling requirements including the COCs, areas of concern, and sampling strategies.

Regulatory Issues

- RCRA compliance issues - need for and practicality of incorporating a liner and/or leachate collection
- Cleanup of adjacent areas under emplacement scenarios
- DOE is initiating the process to expand waste capacity at the ERDF. Use of an entombment alternative could reduce the demand for expanded capacity at ERDF.

HAB issues

- Concern over potential use of clean soils for fill/source of materials for cover
- Reluctance to eliminate alternatives
- Retrievability of wastes
- An exemption under the Hazardous Waste Identification Rule (HWIR) could preclude Ecology control over some aspects of waste disposal
- Role of NRC/DNFSB role in "leave-in-place alternatives
- Which wastes are appropriate for entombment?
- Post-closure monitoring concerns
- Is CERCLA pathway consistent with TPA?
- Which alternatives are consistent with future land use alternatives?

June 16, 1997
221-U DQO Meeting

Location - 221-U Conference Room

Attendees:
P. Innis - EPA,
J. Donnelly - Ecology,
J. Goodenough - DOE-AME,
D. Encke - ERC,
T. Brown -ERC,
R. Borisch - BWHC,
G. Cox - BWHC,
R. Henckel - ERC,
L. Oates - EQM,
M. Miller -EQM,
D. Carlson -Neptune & Co.

Prior to the beginning of the meeting, the majority of those in attendance took an escorted tour of the accessible areas of the 221-U facility. Upon completion of the tour, those present viewed a video walk-through of the canyon deck, illustrating the variety and extent of equipment and materials that are stored in the facility.

Attachment I from the June 10 Global Issues meeting minutes is the list of issues identified at that meeting. The agenda for this meeting is the development of problem statements and decision statements to address those issues that are to be considered in this DQO process. Attendees were polled for input in the form of problems and decisions that had been developed from the June 10 issues list.

EPA and Ecology developed a 2 page list, covering 7 decisions/problems; this list was copied and distributed to the attendees for discussion.(Attachment 1) Ron Borisch and George Cox also provided lists that were copied and distributed.(Attachments 2 &3) Each of the lists cover many of the same issues. Some of the issues that were addressed on these lists include the following:

- Structural integrity should be discussed before the alternatives
- Characterization of the materials within the facility
- Health and safety concerns for workers
- Regulatory drivers for alternatives
- Voids under the structure, soil characterization under the structure need to be evaluated.
- Timing of the alternatives.
- ERDF waste disposal
- Volume questions, volume of what could be added to the existing structure.

J. Donnelly noted that the HAB may have a misconception of how the facility would operate - they see using this facility as a replacement for ERDF and will just have drums of soil.

crucial issue: what if ERDF can handle the waste volume? Turning this facility into a disposal unit may not be needed. However, others in the meeting indicated that ERDF cannot currently accept large pieces of equipment without crushing and repackaging. Using 221U as storage for large equipment which is costly to consolidate to ERDF size criteria, may be cost effective.

R. Henckel noted that the state of underground piping (i.e., the 24" diameter drain) should be included in the decision pathway. It could be included in the discussion of the under-facility void space, since it is the principal one. The integrity of the drain also is important to allow an assessment of its potential utility for leachate collection or as a possible source of leakage from operations.

Although the current regulatory driver and pathway for the facility is CERCLA, there remains some concern with the regulators whether this is the appropriate pathway for the ultimate fate of the facility. Use of an entombment alternative imposes RCRA compliance issues. Related issues include:

- What is the regulatory pathway after an alternative is chosen?
- What are the consequences of changing the pathway at some point in the process?
- If changing the pathway will change data gathering efforts, then changing is critical; otherwise, it isn't.
- RCRA permit requires an EIS; the current pathway does not.

Characterization data for piping and tanks will be needed for both pathways. The attendees agreed that the best approach for the project will be to stay flexible with respect to the regulatory pathway and look at data requirements under both pathways for each decision.

Participants are in agreement that there is not enough available data to evaluate the structural issues and COC issues for the various alternatives.

G. Cox noted that Table B-1 in the FS identifies three phases to each alternative for the facility:

1. Prepare/Modify,
2. Operate, and
3. Close.

Use of this approach to address and group problems could help to make sure problem statements are comprehensive.

The boundary question also needs to be addressed. Boundaries are subject to change, depending on whether a "leave it" alternative (3,4,5,6) or a "take it away" alternative (1,2,6) is chosen. As an alternative to geographical boundaries, structural boundaries could be used for decisions:

1. Galleries,
2. Cells,
3. Canyons,
4. Piping, electrical, wind, ventilation tunnels,
5. External structures,
6. the structure cocoon,

7. Under the structure.

It was agreed to generate a master list of decision statements with the following groupings: Category 1 - entombment, removal; Category 2 - structural data and/or COC data for each sub area (i.e., galleries, cells, etc above); Category 3 - fit decision statements into FS alternatives; Category 4 - evaluate by prep/modify, operation, closure criteria. R. Henckel and L. Oates will generate a second draft of decisions for each category for the meeting on June 18.

221-U Canyon Decision Statements by EPA and Ecology

1. Problem: Section 8 of the TPA specifies the documents required for key facilities. U Plant is a key facility and therefore DOE is required to submit the following:

S&M Phase	Surveillance and Maintenance Plan
Disposition Phase	Project Management Plan
	Facility Disposition End State Criteria Document
	RCRA Closure Plan (if applicable)

Decision Statement: As a key facility, 221-U must go through RCRA closure if there are TSD units within the facility.

- Is there adequate characterization data for the equipment and tanks stored within the tank to determine if the facility is/is not a TSD?
- Is there adequate information to specify the type, location, condition and amount of waste material within the facility to support development of the end state document?

2. Problem: The 221-U Facility is proposed for use as a storage or disposal facility. The structural integrity of the facility is not known.

Decision Statement: Many of the alternatives depend on the structural integrity of the 221-U Facility. Data collected must support further analysis of the alternatives.

- Are they canyon walls able to support weight from interior and exterior material placement?
- Can the canyon floor and cell covers support material placement? Is there a maximum loading?
- If left in place, how long could the exposed walls and roof withstand the elements?
- Is the facility built to withstand seismic events?
- What is the condition of the material under the facility? How much of the material under the facility is fill? What type of fill is under the facility?
- How much void space, including piping, is under and around the facility?

3. Problem: Material/waste quantities within the facility are not known.

Decision Statement: Data collection must support characterization of the waste materials for waste disposal.

- What are the quantities of TRU and TRU mixed waste within the facility?
- Are there any LDR waste stored or contained within the facility?
- Quantities of remote and contact handled waste must be determined.

4. Problem: The ERDF expansion should be on line by FY99. The need for operation of both facilities must be demonstrated.

   Decision Statement: Sufficient information o n waste volumes should be provided to support the need for the canyon as a TSD.
   - Waste volume information must be gathered/developed to support use of the facility. This should include volumes of soils and debris from burial grounds. D&D, and 200 Area remediation. This should be coordinated with the ERDF to determine volumes of debris expected vs. volumes of soil expected with respect to waste stabilization and subsidence issues.

5. Problem: Several of the options include the use of cover material. There are cultural and natural resource issues involved with the use of borrow material.

   Decision Statement: Estimates of the volumes of borrow material needed for the various options and sources for those volumes is needed.

   - Are the material volumes needed coming from culturally sensitive areas?
   - What would the natural resource impacts be from using these materials? This should include land are disturbed, species impacts, and estimated mitigation required.

6. Problem: Health and Safety is a priority during actions taken on site. Much of the needed information for an adequate safety analysis may not be available.

   Decision Statement: Data collected should adequately characterize the facility to determine work risks from environmental and physical hazards.

   - Are there any areas where contamination levels are high enough where remote handling would be necessary? Can this material be characterized sufficiently to dispose of in place if worker risk is a concern?
   - Information gathered should be sufficient to determine ventilation requirements during decontamination, waste storage and waste disposal operations.
   - Information should be sufficient to determine worker exposures during decontamination and waste placement (both within the facility and at other facilities).

7. Problem: If the facility is classified as a nuclear facility, additional requirements would be imposed on using it as a TSD.

   Decision statement: Data collected should be sufficient to determine the total inventory of the facility. If the facility classifies as nuclear, data should be sufficient to complete a SAR.

   - Are inventories available for the vessels, pipes, tanks and other structures within the facility?

221-U List of Decisions

Based on Issues that Require Data for Resolution

1.	Structural Integrity of Building to Handle Waste (also see #39, #40) Is the strength of the structure, structural systems (concrete/steel) and foundation adequate to withstand the loads and load combinations, during and after filling the facility? (i.e., dead, live, vertical and lateral, liquid, thermal, creep, shrinkage, differential settlement, wind and Design Basis Earthquake) Is there a need for additional structural reinforcement? Are site factors (i.e., geology, seismology, meteorology, climatology, hydrology, geotechnical and geochemical) properly incorporated into the structural analysis?
2.	Leach rate through the facility and soil Are foundation drains necessary? Is the integrity of the structural steel/concrete systems adequate to mitigate radiological risk to site or public?
4.	Types of waste present in facility
11.	Regulatory equivalence of liner v. cement
12.	Identification of COCs (facility and surrounding waste sites)
9.	Source of material for backfill
13.	Size of allowable hotspots
16.	TRU determination
15.	PRGs
17.	Infrastructure support Are there existing facilities, utilities, systems, roads, ditches, trenches, etc. (above and below ground) that need to be moved, refurbished or eliminated? Are there cross transfer lines within the footprint plugged with waste?
18.	Exterior facilities
19.	Health and Safety

221-U List of Decisions

Based on Issues that Require Data for Resolution	
20.	Location of underground voids
22.	Waste Stream identification
23.	Backfill source
25.	Monitoring (baseline)
27.	Airborne control
29.	Regulatory pathway, for entombment
30.	Performance assessment
35.	Waste projections (external)
36.	Waste stream Identification
39.	Load bearing capacity of soils (See #1)
40.	Seismic loading (See #1)
41.	Criteria, if used for waste disposal
42.	Condition and description of under canyon drain
-- Are the industrial codes, standards, specifications and guides the right ones, and are they appropriate for the tasks?	
-- Are the design assumptions, including boundary conditions, the right ones, and are they appropriate for the tasks?	

Issues that do not Require Data for Resolution
5. Protection of Groundwater - What model to use?
6. Barrier Design
3. Types of waste facility can accept
7. Geographic Boundary for DQO (facility, canyon; complex v. building)
8. Source of material for barrier
9. Source of material for backfill
10. Identification of compliance with ARARs
14. Waste volume definitions (what is package size?)
Detection limits (PRGs)
24. NRC role
26. Retrievable storage v. permanent storage
28. Regulatory equivalency
21. Allowable voids
31. Method to arrive at alternatives
32. Future land use
33. NRC regulatory guidance
34. Impacts of Hanford 10 year plan on viability of alternatives
37. Intruder protection/institutional control
38. Boundary erosion
43. Accessibility for waste disposal
44. Mobile Metal Melter

June 18, 1997
221-U DQO Meeting

Location: TEA Conference Room (Logston Blvd)

Attendees:
P. Innis - EPA,
J. Donnelly - Ecology,
J. Goodenough - DOE-AME,
D. Encke - ERC,
T. Brown -ERC,
W. Thompson - BHI,
R. Borisch - BWHC,
G. Cox - BWHC,
J. Rugg - BHI,
R. Henckel - ERC,
A. Robinson - EQM,
L. Oates - EQM,
M. Miller -EQM,
D. Carlson -EQM

The attendees were briefed on the output from a matrix prepared by L. Oates, based on the direction from the June 16 meeting. This approach was determined to result in an overly cumbersome process, so an alternative approach was presented to the group. Decisions in the new matrix are stated broadly to allow a large scope and the inputs are used to focus the decision needs. Two tables were created to represent the extreme endpoint of the identified alternatives - one table considers entombment decisions, the second considers removal. All of the data needs from the original meeting and all of the decisions submitted in the 6/16 meeting are accounted for in the new table. Copies of the table were distributed to all attendees and served as the basis for the following discussion. (Attachment 4)

The attendees reviewed each of the decision areas and inputs presented on the table referenced above. The tables were then revised to reflect the consensus of the attendees (A revised table was sent to all participants the afternoon of June 18). Revisions included changes to the language of decisions; elimination, reclassification, and addition of outputs; and identification of outputs. The purpose for collection of specific data was identified as a question that could be incorporated into the decision process.

It was agreed that information which will not contribute to the sampling and analysis plan (SAP) will be listed out separately; this information will not be resolved through this DQO. (Attachment 5) These include, for example, the question of accessibility to tunnels, trenches, and galleries both for inspection and waste placement. An assumption for this project is that the crane will be operational by the end of the fiscal year.

For purposes of analysis, non-process piping was grouped separately from process piping. In the course of discussion, it was noted that there were occasional backflows from process pipes into non-process pipes. In addition, there is asbestos and PCB contamination associated with the non-process pipes. A question was raised whether there are there non-process piping systems that contain enough contamination to affect worker health and safety?

After extensive consideration and discussion of options, it was agreed that the DQO will limit itself to the footprint of the 221 canyon building, including the drain line beneath the building and the subsoils (for purposes of structural integrity). The critical question for the purpose of this DQO is whether or not the canyon can be used for the entombment alternatives. Although other areas adjacent to the facility will require characterization for various alternatives, the characterization of the canyon is considered the time-critical concern for this project. The WR Vault and approximately 30 additional sites external to the canyon will not be included in this DQO.

The issue of leach rates in the concrete led to a discussion of the approach to take for determining this information - a leach test would take 30-90 days. Although the information could be looked up in a book, that approach would require agreement on the book. The cost of conducting the test is minimal. An additional pathway for contaminants may be the joints in the floors and walls. It was pointed out that the joints were grooved which prevents direct pathway for radionuclides. The building was designed in this manner to prevent radionuclide contaminants from escaping the walls and floor.

For the removal alternative, it was agreed that the same issues apply as for entombment, including identification of COCs, health and safety concerns, and waste inventories; waste acceptance criteria should be added to removal inputs. Removal of the building pad and underground drain is assumed to be included in this alternative.

The next steps for the DQO include:

- Summarize input data. Encke, Carlson, Robinson
- Distribute edits of decision table-- Oates
- Create table of inputs and break down into specifics for sampling plan--Encke, Carlson, Robinson
- Think about models that might be useful or apply.

The next meeting, to discuss the inputs for each decision and the decision logic, will be held on the afternoon of June 26 at a location to be determined. A meeting also is tentatively scheduled for Friday, June 27.

Meeting Minutes

221-U Canyon DQO Meeting

June 26, 1997

Attendees:
J. Donnelly - Ecology,
P. Innis - USEPA,
T. Brown - CH2M Hill,
J. Rugg - BHI,
D. Encke - CH2M Hill,
R. Henckel - BHI,
J. Hensley - THI,
R. Winslow - THI,
R. Weiss - CH2M Hill,
K. Jackson - BHI,
J. Baxter - FDNW,
J. Sands - DOE,
D. Carlson - EQM,
M. Miller - EQM,
L. Oates - EQM,
A. Robinson - EQM

A meeting on the above subject was held on June 26, 1997 in meeting room 2B-45 at 3350 George Washington Way.

Decisions and Inputs Table

The purpose column was added to this table. Participants should review the table and provide comments on the purpose and assure that the edits required from the previous meeting were made. Review of the table is needed by July 2, 1997.

This DQO process is to focus on the footprint of the 221-U building. Although the cap, proposed under several of the FS alternatives will cover a large area outside of this footprint, an effective evaluation of the alternatives within the footprint is possible by looking at worst case conditions.

There is not enough characterization data to evaluate the removal alternatives. This DQO is to guide the collection of data to allow the selection of an alternative; it is not intended that the data will be adequate to implement a chosen alternative.

Modeling to Assess Health Effects and Groundwater

Previous waste disposal facilities, such as ERDF, have used modeling and risk assessment to determine the effects of storing the waste at the location. In past meetings, this group has mentioned risk assessment or modeling in a cursory manner. The facilitator added the decision:

"Does conceptual model indicate that groundwater will be protected?"

This decision uses all the information generated by the other decisions and inputs to assess the effect of entombment on the groundwater. In the case of removal, the risk assessment and modeling becomes a standard soil situation because the structure and waste is removed. A decision is underway for another project to assess the risk scenarios and models to be used. This decision should be completed by July 10, 1997. The group decided that the scenario and the model decisions could be delayed, because the information needed by any model was being collected. The facilitator pointed out that running preliminary models for risk allows one to focus resources to gather ONLY the data which drives risk as opposed to doing the shot gun approach on gathering data.

The group agreed to leave the question on the table. The model used for ERDF to generate the inventory limits may be used for this situation. However, the inventory for the canyon is likely to be much higher than for ERDF due the high inventory already in the cells of the canyon.

Data Needs/Sources and Inputs Table

The participants conducted a review of data needs and decisions, following the basic format used in the decisions matrix distributed to attendees. The following summaries of the discussion is grouped by the decision units from that table. This table took each decision and organized it by physical boundary. The previously discussed table is organized by process boundary.

Structural Integrity

Question: Do we need more data for entombment for structure both during and after filling?

John Baxter is the structural engineer working to gather the information needed for this assessment. John indicated that he and others had performed structural assessments on B and T plants which are similar to U plant. The REDOX plant information will also be useful. Much of the information already generated for B and T will be used for this evaluation. John Baxter believes that there will be little new data needed. However, he reserves judgement until he has completed a review of the data needs versus existing information.

All parties agreed that the entombment scenario involves grouting or filling the facility to remove as many void volumes as are reasonable to remove. A discussion of whether heat dissipation during grouting will be a problem followed. If this a problem, one could fill the facility gradually and allow heat to dissipate. During grouting one must assure that the interior an exterior facility are equally supported.

The joints between the concrete building sections are not water tight. The roof of the structure should be maintained. There has been no distress from soil in 53+ years, so there is no reason to expect it in the future.

The GAO report for the B Plant, dated 1989-90, discusses the building integrity. Joints in the concrete structure are located between the cells, approximately every 20 feet. They are sealed with horsehair and cork and probably are not water tight. It is not clear whether the base slab is segmented in the same manner as the building walls; the base was not subject to the same stresses as the walls and may not have been segmented.

J. Baxter will get together with R. Borisch to review the structural assessment materials on hand and data needs, as well as to establish a time frame to evaluate the data needs. One issue to be addressed is the need for a visual examination of the concrete to determine structural integrity of joints.

Electrical Gallery

It was noted that there is some liquid in the sumps in the gallery; one person indicated the sumps had not been characterized. Dave Encke has indicated the sumps were characterized and he is getting the data. PCBs can be expected, based on process knowledge of fixtures used in the operating time frame. It was agreed that there is no basis for analyzing for specific radionuclides in this area; therefore, there is no need to conduct a detailed characterization of radionuclides in the gallery. Gross alpha and gross beta surveys will be performed. Contamination in the electrical gallery is mostly fixed. The one area considered a potential exposure concern is near an expansion located along the outside wall of the gallery.

The word "waste" will be removed from the decision matrix and replaced with "materials" wherever it appears in the inputs column.

Piping Gallery

Selenium is listed as a COPC, based on information provided in the Feasibility study. The question was raised whether selenium is an actual contaminant or if it is a natural background constituent. This issue will be investigated further. Rich Weiss indicated that given the isotopic ratios and process history, there is no reason that ^{237}Np, and ^{228}Th should be present. The technical team also will determine whether other COPCs can be eliminated from specific building areas and will provide justification of this. This applies to all of the areas, not just the pipe gallery.

There is low levels of radionuclide contamination in the gallery. Most of the contamination is fixed; some loose contamination is present in an area on the canyon side of the gallery approximately 2 to 3 feet from the wall.

Operating Gallery

There is a decontamination and shower room at the railroad tunnel end of the gallery which has low levels of alpha contamination, but no beta contamination. The area behind the instrument panels is contaminated, most likely due to blow-back from the process lines. Therefore, instrumentation lines are considered to be contaminated.

Crane Way

The crane is not considered as part of the crane way. The crane itself is considered a part of the canyon deck area. There is no reason to believe that PCBs are present in this area. Airborne contaminants in the crane way are the same as those found in the canyon.

Ventilation Tunnel

The ventilation tunnel is approximately 10 feet by 10 feet. In general, it is expected that the contaminants found on the canyon deck will also be found in the ventilation tunnel. It may not be possible to evaluate the tunnel due to access and exposure concerns. The tunnel may ultimately require consideration as a void space for the structural analysis or filling with grout.

Hot Pipe Trench

The presence of liquids in the pipes must be assessed. The cover blocks to the hot pipe trench are all still in place and there is no rad survey information. Although some information can be found in the Rockwell report for surplus facilities, that information is all pretty general in nature. Uranyl nitrate hexahydrate is a process output; analysis would be covered by assessment for uranium.

Cells

Only equipment still connected to the canyon structure will be considered process equipment native to the 221-U facility; all other equipment will be considered as potentially coming from another facility.

Inside the cells there are reservoirs for excess oil; these reservoirs may contain PCBs. There is no radiation survey data for the cells. Although some dose information is available at the canyon level, there is no accurate data for inside the cells. COPCs from B Plant will be provided for both of the operating scenarios that took place at that facility. Data was just received earlier in the day for B plant COPCs. B Plant processed waste from the tank farms; this was F-Listed waste. The question was posed whether the B Plant equipment is now a listed waste.

Review of the COPCs for the Cells was tables. The technical team will develop a rationale for COPCs to present to Ecology, EPA, and DOE. The schedule for when this list will be ready will be set by Monday, June 30.

Leach Rate of COPCs

Joints in the concrete were used partly to accommodate thermal expansion and partly for settlement. It was suggested that the concrete joints be treated separately for the purposes of leach rate analyses. The joint itself becomes a conduit or flow path, much like cracks in rock or voids in limestone. Water and contaminants can travel anywhere along a joint and adjacent surfaces. There is some fine cracking evident in the concrete, aside from the joints; it is not clear whether these cracks are penetrating or surface cracks.

Analysis of the concrete should be performed both to determine leak potential and rates and to determine options for resolution of any leachate concerns. Sources of liquid in the facility could come from condensation or from penetration of external waters.

The question was posed whether K_d values for concrete can be found in the available literature or if the project should take it upon itself to develop facility-specific values. Would site-specific analyses be required for confirmation of book values? K. Jackson will take the lead on determining what data is available and whether it is adequate for project needs. If available data is not adequate, an approach will be developed for obtaining concrete cores and setting up analyses. How to model flow through the facility under an entombment alternative will be covered outside of this DQO process.

Logic Diagram

A draft logic diagram to guide the decision process was circulated for participant review and comment. This diagram serves as an overview for the process; additional detail is required to more fully define the decision process that will be required.

The first decision point in the diagram addresses the structural integrity issue. It was agreed that without input from the structural experts, it will be difficult to work through the structural aspects of the DQO. Some of the structural issues include degradation potential of the concrete if the facility is left in place and performance aspects, such as seismic concerns, settling , and whether the structure can accept the proposed load(s). Although there is not a safety analysis report (SAR) for facility operations, there is a draft SAR for surveillance maintenance. It was suggested that the NRC limits for Class C waste be considered for incremental loading during emplacement, burial, and consideration of the surface barrier.

In addition to the decision point of whether the structure can physically handle the proposed loading, there was discussion of the ability of the structure to contain the proposed waste - i.e., is there potential for waste to migrate from the facility? This lead to a discussion of whether performance criteria for leach ability were best dealt with as a function of the waste or the structure. If the waste is resistant to leaching, then there is no need to address this aspect of facility performance. In addition, if the contents of the facility are to be encased in concrete or grout, this issue would be moot. The point also was made that most of the waste of concern is encased in equipment and not available for purposes of exposure, with the exception of the limited amounts of existing loose contamination or that on the outside of equipment brought into the facility. For the entombment alternatives, it was stated that encasement can be assumed.

It was agreed that structural adequacy issues will be kept separate from decisions regarding adequacy of containment.

TRU for the purposes of this DQO is defined as greater than 100 nanocuries per gram, based on NRC and DOE regulations. This definition was accepted by Ecology and EPA. It was agreed that the facility itself should have no TRU concerns, because this would not have been a byproduct of the processes that took place at 221-U. Equipment that was brought into the facility from other site operating may have TRU concerns. A phased approach will be used to evaluate this equipment, focussing on concentrations of materials.

BHI presented a recommendation that the materials presently in the canyon should not be considered in the context of the land disposal restrictions (LDR), based on the fact that these wastes were placed prior to RCRA regulation and are being managed within an exiting waste unit. Materials brought in from other locations may need to be evaluated against LDR criteria. EPA noted that there may be a need to know waste concentrations from a risk perspective, independent of LDR concerns. In addition, if the materials are removed for disposal elsewhere, LDR criteria will apply. A discussion regarding calculation methods for evaluating risk ensued. Because the only basis for evaluating against LDR criteria will be if a removal alternative is selected, it was suggested that analysis should be guided by the approach used at ERDF. For non-rad COPCs, LDR criteria will be used, with sampling focussed on areas where liquids are present.

ALARA

There is a need to determine a break point at which ALARA concerns may prevent sampling. Because ALARA is an operations issue, it was agreed that related concerns do not belong on the decision diagram. A summary of ALARA issues will be provided, however, to guide sampling activities.

Action Items

Finish COPC list - D. Encke
Determine Structural Information Needs - J. Baxter
Resolution of LDR concerns - EPA/Ecology
Redo Logic diagram - M. Miller
Detailed Entombment Logic - M. Miller
Summary of Concrete K_ds - K. Jackson
ALARA issues - R. Winslow

ENDPOINT: ENTOMBMENT

BOUNDARY	DECISIONS	INPUTS	PURPOSE
Structure Galleries Canyon Cells Wind Tunnel Hot Pipe Trench	Is there sufficient engineering data available to assess the structural strength/integrity of the facility?	• Maximum load capacity for floors, walls, and roof - internal/external loading (unmodified) • Seismic load • Ventilation & temperature impacts	Determine capacities for cap loading - need for structural reinforcement Compliance with regulatory siting criteria Identify stability concerns
	Is there sufficient information available to identify areas of contamination that may present concerns for worker health and safety?	• Characterization data for equipment, tanks, etc. • Type, location, condition, amount of material/equipment	Determine ALARA concerns Identify special conditions associated with specific locations/equipment Develop sampling protocols
	Is there sufficient information for the facility to assess the radiological inventory for entombment alternatives?	• Characterization data for equipment, tanks, etc. - Class C or less designation - Liquids	Identify criticality concerns Develop total inventory for units and entire facility Identify structural integrity concerns Determine sampling strategies
	Is there sufficient information for the facility to assess the chemical inventory for entombment alternatives?	• Characterization data for equipment, tanks, etc. - LDR - Liquids - Quantities of TRU/ mixed TRU	Determine compliance criteria and concerns Determine sampling strategies Develop total inventory for units and entire facility
	Is there adequate information to determine the leach rate of COCs through the facility concrete and subsurface?	• Transmissivity of concrete • Leach rate of COCs • Transmissivity of canyon floors and walls (including joints) • Transmissivity of RCRA liner	Identify potential disposal concerns Determine potential for leakage Feed into liner compatibility determination

Endpoint: Entombment			
Boundary	**Decisions**	**Inputs**	**Purpose**
Piping, HVAC, and other Support Systems	Is there sufficient information for the non-process support systems to identify system components that may present concerns for worker health and safety?	• Characterization data for piping, HVAC, and associated equipment. - asbestos - PCBs - Liquids - Radionuclides	Identify ALARA concerns Determine personnel protection requirements Develop sampling strategy
	Is there sufficient information for the process pipes to identify system components that may present concerns for worker health and safety, groundwater protection, or disposal?	• Characterization data for piping. - asbestos - PCBs - Liquids - Radionuclides	Determine material characterization Determine personnel protection requirements Develop sampling strategy
Underneath Structure	Is there sufficient information to identify the soil loading/seismic loading capabilities of the soils beneath the structure?	• Amount of void space (including piping) beneath the facility • Integrity of piping	Calculate structural load capacities Determine suitability for operational use
	Is there sufficient information for the 2-foot drain pipe to identify contamination concerns for groundwater protection?	• Characterization data for piping. - PCBs - Liquids - Radionuclides	Determine material characterization Evaluate contamination potential Develop sampling strategy
	Is there sufficient information to determine whether the 2-foot drain pipe can be used for leachate collection?	• Integrity of pipe • Characterization data for piping. - Organics - Radionuclides	Determine material characterization Evaluate liner equivalence

ENDPOINT: REMOVAL

BOUNDARY(IES)	**DECISIONS**	**INPUTS**	**PURPOSE**
Structure Galleries Canyon Cells Wind Tunnel Hot Pipe Trench	Is there sufficient information available to identify areas of contamination that may present concerns for worker health and safety?	• Characterization data for equipment, tanks, etc. • Type, location, condition, amount of material	Determine ALARA concerns Identify special conditions associated with specific locations/equipment Develop sampling protocols
	Is there sufficient information for the facility to assess the radiological inventory for disposal?	• Characterization data for equipment, tanks, etc. - Class C or less designation - Liquids - waste acceptance criteria (WAC)	Identify special conditions associated with specific locations/equipment Develop sampling protocols Evaluate compliance issues/criteria
	Is there sufficient information for the facility to assess the chemical inventory for disposal?	• Characterization data for equipment, tanks, etc. - LDR - Liquids - Quantities of TRU /mixed TRU - WAC	Develop sampling protocols Evaluate compliance issues/criteria
Piping, etc.	process support systems to identify system components that may present concerns for worker health and safety?	• Characterization data for piping, HVAC, and associated equipment. - asbestos - PCBs - Liquids - Radionuclides - WAC	Identify ALARA concerns Develop sampling protocols Evaluate compliance issues/criteria
	Is there sufficient information for the process pipes to identify system components that may present concerns for worker health and safety, groundwater protection, or material disposal?	• Characterization data for piping. - asbestos - PCBs - Liquids - Radionuclides - WAC	Identify ALARA concerns Develop sampling protocols Evaluate compliance issues/criteria

Topic: 221-U: DQO Meeting

Meeting Date: 7/17/97

Attendees:

J. Baxter	FDNW
T. Brown	CH2M Hill
D. Carlson	EQM/Neptune
G. Cox	BWHC
J. Donnelly	Ecology
D. Encke	CH2M Hill
R. Henckel	BHI
P. Innis	USEPA
M. Miller	EQM
Shri Mohan	Ecology
L. Oates	EQM
A. Robinson	EQM
J. Rugg	BHI
J. Sands	DOE
R. Weiss	CH2M Hill

A meeting was held on July 17, 1997, to discuss the sampling strategy for the 221-U facility.

The last 221-U DQO meeting worked through the problems to be addressed through the DQO, identified the decisions and inputs to those decisions, established boundaries for the decisions, and created the logic for the decision-making process. The focus of this meeting was to go through the sampling requirements.

The meeting commenced with discussion of uncertainty and the consequences of making a wrong decision. Analytical errors can be of two types:

1. Concluding that material is above ERDF waste acceptance criteria (WAC) limits, when in fact it is below limits, and

2. Concluding that material is below ERDF WAC limits, when in fact it is above limits. The consequences are more severe for the latter due to potential exposure. The first type of error, however, can result in unnecessary costs for disposal of clean materials.

Data describing the population of interest and action levels to compare the data against are primary requirements for developing the uncertainty analysis. For a large percentage of the target population for this DQO, there is little data available. The WAC for the ERDF are preliminary action levels that are being used for the 221-U facility. The ERDF criteria may need to be modified to fit the population that will be assessed through this DQO.

A statistical sampling approach will not be proposed for the entire 221-U project because the resulting program may not be implementable due to ALARA concerns and access problems. The proposed sampling program will collect data from the Canyon Deck to develop a distribution of the radionuclide constituents. This information will provide a basis for extrapolating the results from survey data collected in areas that can not be sampled. Data quality assessments (DQAs)will be performed on the results from this process to estimate error.

The technical sub-group for the 221-U DQO put together a draft sampling strategy, which was distributed to the attendees as Attachment A. The sampling data developed through the proposed strategy is to support evaluation of the entombment and removal alternatives for the 221-U facility. Some of the issues to be considered as the group reviews the strategy include the following:

- Does the sampling program want to characterize the average concentration of COPCs or the highest concentration?
- What is the contribution of the target area to the facility waste profile?
- What is the contribution of other areas of the facility to the radionuclide inventory when compared to the process cells?
- The sampling design assumes that an isotopic distribution has been developed.
- Is the result likely to effect/drive risk levels?

The meeting walked through the proposed sampling strategy for the facility addressing the various sampling areas in turn. The resulting sampling strategy is included as an attachment to these meeting minutes. The major issues and resolutions for each area are identified below.

Canyon Deck

The estimate of fixed contamination on the deck was summarized in Attachment B, Table 5.6.2-3. Based on the sparse records for the history of equipment storage on the Canyon Deck, it is not reasonable to make any assumptions regarding the past locations of equipment. Sampling will be conducted in a phased approach from three sampling strata; 2-3 samples from each strata. If the results of Phase I sampling indicate that levels exceed the target criteria, Phase II sampling will be implemented. The results from the Canyon Deck sampling will provide the basis for correlating survey data from other parts of the facility to the isotopic distributions.

Issues that remain to be resolved for the Canyon Deck sampling include the depth of samples and target error rates. The decision makers did not want to estimate target error rates until Phase I sampling results are completed. A DQA will be done after collection of Phase I. The DQA will:

- Evaluate statistical and spatial distribution
- Evaluate error rates for $\propto$ and β.
- Allow all parties to review error rates and distribution prior to Phase II.

<u>Galleries</u>

There is a considerable amount of survey data available for the galleries. The contribution of the contamination within the galleries to the total inventory for the facility is considered to be small. Because of these factors, no radionuclide sampling is to be performed in the galleries. The survey data will be assessed using isotopic distribution from the Canyon Deck, Phase I. This led to a discussion of the rationale for sampling and the size of the sample population. The point was made that the need for additional sampling should take into account the number of existing data points and where the mean and variance for this data are situated with respect to the target criteria. Once the relationship is established with some level of confidence and comfort, additional data will provide little additional benefit for the decision-making process.

Composite samples will be collected from the sumps in the electrical gallery and analyzed for radiological and non-rad COPCs. The number of sumps that will contribute to each composite will be established in the SAP. The sump samples should represent a worst-case estimate of contaminants transportable as liquid.

<u>Galleries-Piping</u>

The pipes will be evaluated to determine whether there is any standing liquid remaining in them. Ultrasound or sonar will be evaluated for use in this area. Because there is little problem with access, it may be as efficient to tap on the pipes and to find drain lines for these systems. The piping will be grouped into that which is process piping and that which is non-process. One composite sample of liquid for each type will be collected (if liquid is available) from the low points in each system. A rad survey of the piping will be performed to support the facility inventory.

<u>Crane Way</u>

The Crane Way is considered a special case within the Canyon Deck; it shares the same air space. There is rad survey data for the Crane Way which generally resulted in non-detects. Existing data will be used to characterize rad levels on Crane Way. A visual survey will be performed to identify potential locations of non-rad contamination (e.g., stained areas). If sites are located that merit evaluation, samples will be collected and composited.

Railroad Tunnel

No historical data exists for the railroad tunnel. Radiological data will be generated through a survey. Non-rad COPCs will be evaluated through composite sampling of areas targeted through a visual survey.

Ventilation Tunnel

Accessibility is a major concern for the ventilation tunnel. The COPCs for the tunnel are assumed to be the same as for the process cells; isotopic distribution is assumed to be a weighted average from process cell data. A robot will be used to conduct a video survey of the ventilation tunnel and to collect composite samples of dust for rad and chemical COPCs. The number and location of samples will be determined based on visual information gathered by the robot.

Hot Pipe Trench

The Hot Pipe Trench runs process piping between sections and cells. Because of the number of pipes and bracing within the Hot Pipe Trench and the fact that the structure is extremely "hot," access for sampling is extremely limited. The preferred approach for characterizing the Hot Pipe Trench will be to use the COPC analysis for adjacent cells, which would have been exposed to the same materials and likely would have high levels of contamination.

An attempt will be made to perform non-destructive testing (NDT) of the pipes to determine the presence of liquids. Because of the concentration of piping in the trench, it is not clear that the technology will be capable of resolving this issue on a pipe-by-pipe basis. If NDT is not viable, the alternative for determining the presence of liquids for the purposes of this DQO is to open traps and pipes.

Cells

There are 40 cells in total; for this DQO, they were grouped into four types of uses - uranium recovery, waste treatment, solvent treatment, and miscellaneous purposes. Some of the cells were used for more than one purpose. The approach that will be used in this study is to consider only that equipment that is still physically attached to the structure as 221-U process equipment. Because of the lack of definitive records, all other equipment will be considered as coming from some other site; all this equipment is considered non-process equipment absent some basis to believe otherwise. It is assumed that non-process equipment was placed in the cells due to a high exposure concern.

In response to the comment that all cells drained to cell #10 through floor drains, an observation was made that a cell in section 2 or 3 is believed to not have a floor drain. **Action Item: Tom Brown will attempt to resolve this question.**

Sampling of cells through a statistical approach is not possible due to the jumble of equipment present in most cells. All cells will be opened and their contents video-taped. The goal for the cells will be to obtain concrete samples from 2-3 cells from each of the 4 functional groups identified above. Samples will be collected near the low point in the cell, when possible.

Core Sample

At least one concrete core, of a depth to be determined in the SAP, will be collected from one of the waste treatment and uranium treatment process function cells. If it proves difficult to obtain samples around the equipment, cells will be selected for sampling where equipment can be moved.

Alternatives to sample collection from the floors of the cells include:

- collection of samples from the cell walls, and
- collection of samples from the adjacent pipe trench.

The depth of penetration required for coring, critical configurations for equipment, and location of samples will be left to the technical group and SAP to resolve.

A gamma scan will be performed for each cell with the goal of gathering a total radionuclide inventory for the cells. The TRU determination will be made based on liquid and concrete analyses.

Cell #10 is considered to be the same as the other cells, except that it contains a large tank instead of equipment. One sample will be collected from liquid in the tank.

Cell Equipment

Equipment also will be grouped according to process and function knowledge. Equipment will be surveyed for liquid, through visual or NDT. Two samples will be collected from each type of process equipment to determine the rad and non-rad COPCs. Non-process equipment will be identified to the extent possible. That which can be related to equipment on the Canyon Deck will not be sampled; results from the related equipment will be extended to that in the cells. If a piece of equipment can not be related to other non-process equipment, liquids will be sampled. It was noted that the lubricating oil has been determined to not contain PCBs, based on discussions with the manufacturer, Texaco Oil.

Canyon Deck Equipment

By definition, there is no process equipment on the Canyon Deck. A shielded gamma scan will be used to assess the inventory for individual pieces of equipment. Decision makers agreed that it is not intended to sample every piece of equipment. Equipment will be grouped by facility of origin and liquid samples will be collected for each category. The SAP will delineate the sampling approach.

Fuel shipping casks will be evaluated to ensure that no fuel is present. Total void spaces in the equipment will be estimated to determine concerns and remedial needs associated with subsidence under entombment alternatives.

Pipe Drain

The pipe drain collected drainage from all of the process areas of the facility and fed it to the tank in cell #10. A video survey for a similar drain in the B Plant revealed significant problems obtaining information about the integrity of the line due to material on the walls of the pipe. **Action Item: George Cox will attempt to locate the video from B-Plant and any associated information.** A video survey of this pipe is planned to determine whether there are any significant concerns with the pipe's integrity. The robot used to make the video also will be equipped to collect one composite sediment or liquid sample, if sludge/liquid is present. Soil samples will not be collected unless the pipe is severely cracked or damaged, or other integrity issues are revealed from the video.

ATTACHMENT A

OUTLINE OF SAMPLING LOGIC

Galleries (Concrete)

There is a large amount of survey data available for the galleries.

- Radionuclides: propose no sampling; survey data for the galleries indicates that dose levels are well below the dose level in the canyon- the inventory in the galleries is minute compared to canyon inventory

- Chemicals: obtain data through a composite sampling approach from the sump contents in Electrical Gallery; SAP to develop strategy for how many sumps per composite. Use as a worst case for all galleries

Composite sampling was adopted as the preferred approach. Sample sludge/liquid <u>NOT</u> concrete.

Galleries (Pipes)

- Verify no free-standing liquid by NDT or visual; note any that contain liquid and estimate the volume. ID and group pipes as process, non-process to be looked at separately.

- Radionuclides: propose no sampling based on process knowledge and same rationale as above - perform an extended rad survey of the pipes for inventory information

- Chemicals: collect several samples from low points and create one composite sample for the process piping, one for non-process piping

Crane Way (Concrete)

Rad survey data for the Crane Way generally shows non-detect

- Airspace from Canyon Deck extends to Crane Way

- Radionuclides: use existing survey data with distribution based on samples from concrete deck

- Chemicals: collect biased samples based on rad survey and visual inspection for discoloration; composite sample for 1 analysis

Crane Way (Pipes)

None.

Cells (Concrete)

There are a total of 40 cells; however, some cells were used for more than one process over their life time. Video each cell as inspected

- Divide cells by process: 20-uranium recovery, 10-waste treatment, 8- solvent treatment, 8-misc. (Some were used for more than one process)

- Visually inspect for liquid or use NDT if applicable

- If liquid in cell, sample liquid and floor concrete (concrete cores 3-6 inches)

- Collect a core sample of floor concrete (concrete cores 3-6 inches) in any cell where concrete is accessible for sampling. Collect at least one core each from concrete in cells associated with uranium and waste processes. Attempt to collect at least one additional concrete sample from concrete surface, from each process group, from the floor or walls of the cell. Target the corner of the cell near the drain line, when possible. Collect additional samples if visual evidence suggests potential for elevated contamination. Sampling technique to be addressed in SAP. Move equipment to collect sample if necessary. Collect maximum of three samples per process (including any cores) and do not composite.

Alternatives = (1) sample from related portion of the pipe trench, with same process; or (2) gamma scan of cell and use distribution from related process knowledge.

Cells (Equipment)

- Divide cells by process (T.Brown); visually inspect for inventory
  - Jumpered or otherwise installed equipment is assumed 221-U process equipment
  - Not jumpered or otherwise installed equipment is assumed non-process

- Verify no free standing liquid in process equipment - use NDT when possible; regulations allow a heel to remain
  - If liquid found, estimate volume (keep equipment oil and oil associated with electrical equipment volumes separate from the volumes of the liquids), collect a sample of liquid if possible (keep two types of oil separate)

  - If no liquid found, assume remaining residual contamination will not greatly contribute to overall inventory

- Gamma survey of each cell

- Process Equipment: submit 2 samples from each process; sample 1 should come from the equipment with the most liquid or the highest rad survey; sample 2 should be an oil sample from any oil used in electrical equipment such as transformer; store the unused samples in the canyon in case additional characterization is required

  - Develop total liquid inventories for each process.

- Non-process equipment: identify the process the equipment was associated with. Collect oil from any equipment used for electrical support, has PCB concern. Track estimated volumes of any liquid, oil, or oil associated with electrical equipment.

- Collect liquid/sludge sample from tank in Cell 10

Pipe Drain

- Special case of cells; currently no historical data

- Obtain a video of the inside of the pipe: determine if/where liquid is entering pipe drain; determine the integrity of the pipe; determine if/where liquid is present

- Radionuclides: survey the length of the pipe; assume same isotopic distribution as Cell 10

- Chemicals: if sludge and/or liquid present, collect a sample - 1 composite for each (liquid, sludge). If no liquid, do not collect a sample; assume residual contamination does not significantly contribute to the chemical inventory of the facility.

Railroad Tunnel (Concrete)

- Currently no historical data

- Radionuclides: survey the floor area and assume the same isotopic distribution as indicated by the data from the canyon deck

- Chemicals: collect biased samples at discolored spots based on visual inspection; composite for 1 analysis

Ventilation Tunnel (Concrete)

- Currently no historical data,

- Assume concrete concentration is weighted average of all process cells

- Condensate was likely during operation, UO3 process used same tunnel, drains to sump Use a robot to conduct a visual survey and sampling of the ventilation tunnel

- Radionuclides: survey the length of the tunnel and assume the same isotopic distribution indicated by the data from the cells and/or canyon deck core samples

  - Collect sediment/dust sample from loose sediment/dust, selecting material based on video/robotic observations. Composite sample(s)

- Chemicals: collect samples from loose dust/sediment in ventilation tunnel. Composite sample(s)

Ventilation Tunnel (Pipes)

None.

Hot Pipe Trench (Concrete)

- Currently no historical data. Accessibility is a critical issue

  - Calculate rad. and chemical inventory in the concrete based on the results from concrete samples in the process cells from the same process.

Hot Pipe Trench (Pipes)

- Verify the pipes have no free standing liquid

- Survey the pipes and, if possible, use NDT to find liquid in the pipes.

- Perform rad survey of trench including pipes.

  - If NDT is not possible, testing will not take place. If no liquid is found, no samples will be collected.

Canyon Deck (Concrete)

The Canyon Deck is the most readily accessible area for collection of samples that can be used to develop radionuclide distribution.

- Do not assume that the current location of the equipment on the deck provides a rationale for stratification; currently no data for distribution: spatial or isotopic. Necessary because some of the other boundaries will use canyon deck isotopic distribution.

- Historical data reflects removable radioactive contamination, not fixed contamination. Some swipe data is available.

Sampling Approach:

- Radionuclides: perform a Phase I stratified sampling activity in those areas accessible without removing equipment. Because there is no driver for COPCs to penetrate the concrete, samples do not need to characterize depth. Use random sampling in three strata (1) walkway, (2) open areas, (3) areas near equipment without moving the equipment; collect 2 - 3 samples per area; estimate of the proportion of each area to the total area) to:

  - get an estimate of spatial variability, weighted average of concentration
  - get an indication of vertical variability via cores
  - determine whether ERDF limits will be exceeded, determine error rates; if limits greatly exceeded and error rates are reasonable, Phase II sampling not be needed.
  - If phase II sampling is required, collect samples as equipment is moved for cell sampling

- Chemicals: same as for radionuclides

Canyon Deck (Equipment)

- Assume all equipment is from B-Plant, REDOX, PUREX, or U-Plant

- Verify equipment has no free standing liquid (or has allowable heel, if applicable)

- Radionuclides and Chemicals: Stratify equipment by function and origin (i.e., facility of origin), if available; sample each process/origin combination - Use photos to develop initial grouping of equipment by process/origin

  - Sample liquid, if present; estimate volume of liquid present in all equipment
  - Sample scale/sludge, if present
  - If neither is present, perform a shielded gamma scan of the equipment and use distribution to assess concentrations

- Verify no fuel in fuel shipping casks
- Estimate total void space

Plan is <u>not</u> to sample every piece of equipment on the canyon deck

Topic: 221-U: DQO Meeting

Meeting Date: 7/21/97

Attendees:

J. Baxter	FDNW
T. Brown	CH2M Hill
G. Cox	BWHC
D. Encke	CH2M Hill
R. Henckel	BHI
P. Innis	USEPA
M. Miller	EQM
L. Oates	EQM
J. Rugg	BHI
J. Sands	DOE
R. Weiss	CH2M Hill

A meeting was held on July 21, 1997, to review the selection of the contaminants of potential concern (COPCs) and structural decisions for the 221-U Canyon disposition alternatives.

COPCs

A table (Attachment A), distributed to attendees at the previous 221-U DQO meeting (July 17, 1997), presents the following information:

- the preliminary list of COPCs by source (i.e., U Plant, B Plant, Redox, PUREX),
- analytical methods for each COPC,
- a rationale for sampling, or excluding, each COPC by media, and
- target analytes and detection limits.

This table provided the basis for the review of the recommended approach for the selection of COPCs.

The list of COPCs by source was developed based on historical information and process knowledge for each facility; this information is too detailed for an efficient discussion of COPCs. In order to focus the discussion, the list beginning on page 16 of the handout was used as a starting point. This table was the product of a review of all COPCs by the technical team. The team looked at the individual contaminants and evaluated whether there is a justifiable basis to search for the COPCs listed on pages 1 through 13. This determination was based on process knowledge, history of the plant operations, knowledge of the operations at plants that contributed equipment, potential risk associated with specific contaminants, half life of radionuclides, and assessment of parent versus progeny for nuclides.

As a first step, the attendees reviewed those COPCs identified by the technical team as candidates for removal from the list:

- Bismuth Phosphate - it was agreed that there is no reason to sample for this substance because it presents no potential risk
- Diatomaceous earth - a silicon-based material, it is not a hazardous material
- Ferrous aluminum sulfate - not a risk driver
- Oil and Grease - there are no specific issues associated with this class of substance; PCBs are covered elsewhere
- Potassium hydroxide - any potential concerns will be addressed in the pH screen
- Potassium permanganate - although not a hazardous material, it can facilitate groundwater transport; however, it is not considered to be present in significant volumes
- Selenium - has not been identified as present in any process
- Cs-134 - not a concern due to its reasonably short half life (2 years); it will show up in the gamma analysis
- Radium - will be present as naturally occurring material in the concrete, but not present otherwise.

There was no concern expressed among those in attendance regarding the removal of the identified COPCs from the investigation list; some of the reasoning will be modified, as reflected in the attachment to these minutes.

Some of the remaining COPCs will be evaluated primarily through visual inspection:

- Acetylene tetrabromide was use in manometers. Due to its distinctive red coloring, if a red fluid is found in the manometers, it will be assumed to be acetylene tetrabromide and removed.
- Aluminum and zirconium fines are considered to be more of an airborne safety concern than a risk driver for disposition alternatives. These will be evaluated through visual inspection.

Several of the COPCs were discussed in greater detail, regarding their potential use at the facility, associated risk, and approach in the investigation:

- Citric Acid, D2EHPA, EDTA, HEDTA, ACOH, used as chelators in B Plant, were identified as a COPC because of their potential role in facilitating transport of radionuclides. Small amounts also may have been used for decontamination. Because the B Plant equipment would have been drained prior to moving it to U Plant, there is no reason to believe it will be present in significant quantities. If large volumes are encountered, the liquid will be removed, eliminating any potential associated risk. Therefore, these do not need to be COPCs. These analytes are not prohibited for disposal.

- Tributyl Phosphate (TBP) was used to extract uranium; it is not water soluble. It was generally present in association with kerosene (kerosene is a COPC). TBP analysis requires use of GC/MS; this is the only COPC that would require this technique. Because TBP will only be a concern if it is present in large quantities, and large quantities of any liquid will be removed under all alternatives, it will only be looked for in Tank 5-6 and in other tanks if a significant non-oil organic layer is found. A gross estimate of volumes will be developed to determine disposal requirements.

- Np-237 is a low-yield alpha emitter; it will probably not be seen in analyses.

- U plant and B Plant should never have seen thorium in their processes; there should be a very limited number of locations where it might be present. **Action Item: R. Weiss provide potential locations for sampling.**

- Uranium analysis should be isotopic analysis for the concrete and sludge from Tank 5-6; all other locations should look for total U.

Action Item: Rich Weiss will develop tables of detection limits/methods for radionuclides.

The point was made that if the 222S laboratory is to provide analytical support, a strong case will need to be provided regarding no PCBs present.

Aside from the discussion summarized above, there were no revisions to the rationale for sampling. A revised table is attached to these meeting minutes and will be included in the body of the DQO Report, along with an analyte list.

A question was raised whether there would be any benefit to adopting higher detection limits for the analytes of concern. R. Weiss responded that there is little cost saving associated with such an approach, but there may be an advantage in turnaround time for samples and volume of sample required. The analyte table will be modified to present a statement regarding the sample size/detection limit issue; sample size for some of the indicated analyses may result in problems acquiring an adequate sample or cold result in ALARA concerns for sampling and/or analytical personnel.

The point was made that the list of analytes is intended to represent the COPCs for the facility as a whole, it is not mean to indicate that all COPCs are to be looked for in all media in all locations. The DQO report will contain text to reinforce this point.

Structural Issues

John Baxter distributed a new version of the decision process for structural analysis.

As a starting point, J. Baxter noted that there is a need to distinguish between an evaluation of the structure as a candidate for future process operations and an evaluation against a safety envelope for operations under the proposed disposition alternatives. In general, for the proposed alternatives, the primary issue will be one of cost; there are no apparent major weaknesses that would preclude any of the proposed alternatives.

The decision statements were reviewed and provided the basis for inputs. Subsequent to and based on the discussion, the decisions were revised to read as follows:

- "What is the structural capacity of Building 221-U for all loadings that will be encountered during and after entombment?"
- "What are the flow paths into and out of the 221-U Building?"

The second decision includes two primary components - (1) cracks, joints, and openings, and (2) bulk properties (e.g., leachability, Kd).

The decision process in the handout was structured around an ASCE procedure, reference #1 in the handout. In general the process includes a document review, site inspection, and structural analysis. While these methods are fairly standard for analysis of the structure itself, the evaluation of the flow path is more difficult. Prior structural assessments of U Plant or other Hanford structures (e.g., B Plant) have not looked at flow paths. It is clear that the numerous sizeable penetrations in the structure would need to be addressed under any entombment alternative. What data will be required beyond visual inspection is not clear at this point in time.

A certain amount of coring is recommended to determine the current status of the structure and to project the long-term effects of soil chemistry on the integrity of the concrete and rebar. Some of the data generated through cores at B Plant can be extrapolated to U Plant, but site specific cores will show the compressive strengths of the concrete and the local effects of soil on the concrete.

There are two kinds of concrete used in the facility - a high quality concrete for the cells and cell cover blocks, and a medium grade concrete for the rest of the structure. It is proposed to take three core samples for each of the two concrete types. Samples from the high grade concrete will be assessed for leachability; samples from the medium grade concrete will be evaluated for compressive strength, durability, and degradation. The latter samples should be collected from the side walls, outside of the building, preferably from an area that is not contaminated with radionuclides. The former should be collected from cell cover blocks.

The question of whether the facility can store waste to meet RCRA (30 years) or NRC (500 years) criteria is to be determined in the feasibility study, not through the DQO.

Action Item: J. Baxter will look into who can do source term modeling in the context of potential flow from the facility.

The normal course of events for structural analysis would involve a materials analysis and a baseline analysis. For the 221-U Canyon facility, the problem lies in that much of the baseline information is missing. There are no "as-built" drawings for the facility. Engineering calculations may be available from the original design engineers, but those drawings would need to be purchased; there may be liability concerns associated with that process.

Action Item: J. Baxter will develop two tables (one each for structural and leachability), similar to the one developed for COPCs, that will list the type of information required, whether it is currently available, the source, if it is available, and where it can be found if not available. He also will provide the methods that are used to perform any required analyses, along with the size and number of samples required. Until a determination is made whether sufficient information is available to provide Kd values for concrete, a decision on the need for leachability testing will be held off.

The current schedule calls for a draft DQO report by August 8. It was agreed that the structural information will be placed in a separate chapter from the sampling design and radionuclide/ chemical analyses.

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APPENDIX C

EVALUATION OF PROCESSES AND EQUIPMENT FOR COPCs

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Table C-1. 221-U Canyon Functional Processess with Equipment and COPC (Page 1 of 4)

Section #	Cell #	Simplified Function(s)	TBP Process Equipment	Contaminants of Potential Concern (COPC)
1	1	Empty		UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
	2	Empty		UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
2	3	RR Tunnel		UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
	4	RR Tunnel		UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
3	5	Uranium Recovery	Feed Receiver Tank (3-1)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	6	Uranium Recovery	Feed Receiver Tank (3-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
4	7	Uranium Recovery	Feed Utility Holdup (4-1)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	8	Uranium Recovery	Waste Utility Holdup (4-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
5	9	Uranium Recovery	Organic Sump Holdup (5-1)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
	9	Uranium Recovery	Aqueous Sump Holdup (5-2)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
	10	Uranium Recovery	Deep Cell Sump (5-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, FE3+, NH4, TBP, Kerosine
6	11	Uranium Recovery	Concentrator Feed Cooler (6-2)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	11	Uranium Recovery	Feed Concentrator Tower (6-4)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	11	Uranium Recovery	Feed Concentrator Condensor (6-5)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	12	Uranium Recovery	Feed Concentrator Feed (6-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	12	Uranium Recovery	Concentrator Feed Receiver (6-7)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
7	13	Uranium Recovery	Concentrator Feed Cooler (7-2)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	13	Uranium Recovery	Feed Concentrator Tower (7-4)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	13	Uranium Recovery	Feed Concentrator Condensor (7-5)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3

Table C-1. 221-U Canyon Functional Processess with Equipment and COPC (Page 2 of 4)

Section #	Cell #	Simplified Function(s)	TBP Process Equipment	Contaminants of Potential Concern (COPC)
	14	Uranium Recovery	Feed Concentrator Feed (7-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	14	Uranium Recovery	Concentrator Feed Receiver (7-7)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
8	15	Spare	Concentrator Spare Cooler (8-2)	
	15	Spare	Spare Concentrator Tower (8-4)	
	15	Spare	Spare Concentrator Condensor (8-5)	
	16	Spare	Spare Concentrator Feed (8-6)	
	16	Spare	Concentrator Spare Receiver (8-7)	
9	17	Waste Treatment	Concentrator Waste Cooler (9-2)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	17	Waste Treatment	Waste Concentrator Tower (9-4)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	17	Waste Treatment	Waste Concentrator Condensor (9-5)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	18	Waste Treatment	Waste Concentrator Feed (9-6)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	18	Waste Treatment	Concentrator Waste Receiver (9-7)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
10	19	Waste Treatment	Concentrator Waste Cooler (10-2)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	19	Waste Treatment	Waste Concentrator Tower (10-4)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	19	Waste Treatment	Waste Concentrator Condensor (10-5)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	20	Waste Treatment	Waste Concentrator Feed (10-6)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	20	Waste Treatment	Concentrator Waste Receiver (10-7)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
11	21	Waste Treatment	Waste Sampler (11-1)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	22	Waste Treatment	Neutralizer (11-6)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
12	23	Waste Treatment	Waste Sampler (12-1)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	24	Waste Treatment	Waste Sampler (12-6)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
13	25	Waste Treatment	Waste Sampler (13-1)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine
	26	Waste Treatment	Pooled RAW-ROW (13-6)	UNH, SO4, PO4, NO3, OH, CL-, Na, FE3+, NH4, TBP Kerosine

Table C-1. 221-U Canyon Functional Processess with Equipment and COPC (Page 3 of 4)

Section #	Cell #	Simplified Function(s)	TBP Process Equipment	Contaminants of Potential Concern (COPC)
14	27	Uranium Recovery	40 HP Bird Centrifuge 40" (14-1)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	27	Uranium Recovery	Centirfuge Catch (14-2)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	28	Uranium Recovery	40 HP Bird Centrifuge 40" (14-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	28	Uranium Recovery	Centirfuge Catch (14-7)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
15	29	Uranium Recovery	RCU Sampler (15-1)	UNH, HNO3, CL-, TBP, Kerosine
	30	Uranium Recovery	RCU Sampler (15-6)	UNH, HNO3, CL-, TBP, Kerosine
16	31	Uranium Recovery	RCU Receiver (16-1)	UNH, HNO3, CL-, TBP, Kerosine
	32	Uranium Recovery	RCU Receiver (16-6)	UNH, HNO3, CL-, TBP, Kerosine
17	33	Uranium Recovery	RC Column (17-2)	UN, HNO3, CL-, Pu
	33	Uranium Recovery, Solvent Treatment	RCW Receiver (17-1)	UN, HNO3, TBP, Kerosine
	33	Uranium Recovery	RCU Pump Out (17-3)	UNH, HNO3, CL-, TBP, Kerosine
	34	Uranium Recovery	RAF Feed (17-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	34	Uranium Recovery	RAW Receiver (17-7)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, (H2NSO3)-, H+, Na+, FE++, NH4, TBP, Kerosine
	34	Uranium Recovery	RA Column (17-8)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, TBP, Kerosine
18	35	Solvent Treatment	ROO Receiver (18-1)	Kerosine
	35	Solvent Treatment	RO Column (18-2)	UN, HNO3, Na2SO4, H2SO4, H3PO4, TBP, Kerosine
	35	Solvent Treatment, Waste Treatment	ROW Receiver (18-3)	UNH, Na2SO4, H2SO4, H3PO4, TBP, Kerosine
	36	Uranium Recovery	RAX Feed (18-6)	TBP, Kerosine
19	37	Uranium Recovery	RC Column (19-2)	UN, HNO3, CL-, Pu
	37	Uranium Recovery, Solvent Treatment	RCW Receiver (19-1)	UN, HNO3, TBP, Kerosine
	37	Uranium Recovery	RCU Pump Out (19-3)	UNH, HNO3, CL-, TBP, Kerosine
	38	Uranium Recovery	RAF Feed (19-6)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3
	38	Uranium Recovery	RAW Receiver (19-7)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, (H2NSO3)-, H+, Na+, FE++, NH4, TBP, Kerosine
	38	Uranium Recovery	RA Column (19-8)	UNH, SO4, PO4, NO3, CO3, OH, CL-, Na, HNO3, FE(NH4)2(SO4)2, H2NSO3, TBP, Kerosine
20	39	Solvent Treatment	ROO Receiver (20-1)	Kerosine
	39	Solvent Treatment	RO Column (20-2)	UN, HNO3, Na2SO4, H2SO4, H3PO4, TBP, Kerosine

Table C-1. 221-U Canyon Functional Processess with Equipment and COPC (Page 4 of 4)

Section #	Cell #	Simplified Function(s)	TBP Process Equipment	Contaminants of Potential Concern (COPC)
	39	Solvent Treatment, Waste Treatment	ROW Receiver (20-3)	UNH, Na2SO4, H2SO4, H3PO4, TBP, Kerosine
	40	Uranium Recovery, Solvent Treatment	RAX Feed (20-6)	TBP, Kerosine

Note: The following Radio Isotopes are a COPC in all cells: 241Am, 60Co, 134Cs, 152Eu, 154Eu, 237Np, 238Pu, 239/240Pu, 226Ra, 90Sr, 228Th, 234U, 235U, 238U

Table C-2. B Plant COPC Assessment (Page 1 of 4)

COPC	8-1, Tank	Centrifuges	P-27-3, Pump	P-28-3, Pump	1A-12-1, Agitator	A2-A19-1-1, Agitator	2A-30-3, Agitator
Bismuth Phosphate							
Citric Acid			X	X			X
Di-2-(ethylhexyl)phosphoic acid (D2EHPA)			X	X			X
Diatomaceous Earth	X						
Ethylenediamine tetraacetic acid (EDTA)			X	X			X
Hydroxyacetic acetic acid (ACOH)			X	X			X
Hydroxyethylene diamine triacetic acid (HEDTA)			X	X	X	X	X
Lead							
Nitric Acid			X	X	X	X	X
Normal Paraffin Hydrocarbon			X	X			X
PCBs							
Phosphoric Acid			X	X			X
Rare earth nitrate					X		
Sodium Carbonate			X	X	X		X
Sodium Gluconate			X	X			X
Sodium Hydroxide			X	X	X	X	X
Sodium Nitrite							
Sodium Sulfate					X		X
Tributyl Phosphate			X	X			
Am-241							
Co-60							
Cs-134						XX	
Cs-137						XX	
Eu-152							
Eu-154							
Np-237							
Pu-238							
Pu-239/240							
Ra-226							
Ra-228							
Sr-90		XX					XX
Th-228							
U-234							
U-235							
U-238							
Gross Alpha							
Gross Beta							
GEA							

Note: Blocks with double x's means the equipment was used for that isotope separation at B Plant.

Table C-2. B Plant COPC Assessment (Page 2 of 4)

COPC	F-22, Filter	1G-13-2, Centrifuge	1C-27-1, Pulser	Centrifuge	31-1, Tank	Jumpers	32-2, Centrifuge
Bismuth Phosphate			X				
Citric Acid			X				
Di-2-(ethylhexyl)phosphoic acid (D2EHPA)		X					
Diatomaceous Earth			X				
Ethylenediamine tetraacetic acid (EDTA)			X				
Hydroxyacetic acetic acid (ACOH)			X		X		X
Hydroxyethylene diamine triacetic acid (HEDTA)							
Lead			X		X		X
Nitric Acid			X				
Normal Paraffin Hydrocarbon							
PCBs			X				
Phosphoric Acid					X		X
Rare earth nitrate			X		X		X
Sodium Carbonate			X				
Sodium Gluconate			X		X		X
Sodium Hydroxide							
Sodium Nitrite			X		X		X
Sodium Sulfate							
Tributyl Phosphate							
Am-241							
Co-60							
Cs-134							
Cs-137							
Eu-152							
Eu-154							
Np-237							
Pu-238							
Pu-239/240							
Ra-226							
Ra-228							
Sr-90		XX		XX	XX		XX
Th-228							
U-234							
U-235							
U-238							
Gross Alpha							
Gross Beta							
GEA							

Note: Blocks with double x's means the equipment was used for that isotope separation at B Plant.

Table C-2. B Plant COPC Assessment (Page 3 of 4)

COPC	Ti-Tube Bundles	9-1, Tank	12-6, Tank	Pipe Wrench	35-1, Tank	13-1, Tank	Dissolver	SP-5, Tank
Bismuth Phosphate								
Citric Acid								
Di-2-(ethylhexyl)phosphoic acid (D2EHPA)								
Diatomaceous Earth						X		
Ethylenediamine tetraacetic acid (EDTA)								
Hydroxyacetic acetic acid (ACOH)								
Hydroxyethylene diamine triacetic acid (HEDTA)					X			
Lead								
Nitric Acid					X			
Normal Paraffin Hydrocarbon								
PCBs								
Phosphoric Acid								
Rare earth nitrate								
Sodium Carbonate								
Sodium Gluconate								
Sodium Hydroxide		X			X			
Sodium Nitrite		X						
Sodium Sulfate								
Tributyl Phosphate								
Am-241								
Co-60								
Cs-134								
Cs-137					XX			
Eu-152					XX			
Eu-154								
Np-237								
Pu-238								
Pu-239/240								
Ra-226								
Ra-228								
Sr-90								
Th-228								
U-234								
U-235								
U-238								
Gross Alpha								
Gross Beta	X			X				
GEA	X			X				

Note: Blocks with double x's means the equipment was used for that isotope separation at B Plant.

Table C-2. B Plant COPC Assessment (Page 4 of 4)

COPC	Tank Coil	E-20-3, Condenser	Centrifuge A-Frame	J-8	Condenser	HAPPO Shipping Casks
Bismuth Phosphate						
Citric Acid						
Di-2-(ethylhexyl)phosphoic acid (D2EHPA)						
Diatomaceous Earth						
Ethylenediamine tetraacetic acid (EDTA)						
Hydroxyacetic acetic acid (ACOH)						
Hydroxyethylene diamine triacetic acid (HEDTA)		X				
Lead						
Nitric Acid		X				
Normal Paraffin Hydrocarbon						
PCBs						
Phosphoric Acid						
Rare earth nitrate						
Sodium Carbonate						
Sodium Gluconate						
Sodium Hydroxide		X				
Sodium Nitrite						
Sodium Sulfate						
Tributyl Phosphate						
Am-241						
Co-60						
Cs-134						
Cs-137		XX				
Eu-152		XX				
Eu-154						
Np-237						
Pu-238						
Pu-239/240						
Ra-226						
Ra-228						
Sr-90						
Th-228						
U-234						
U-235						
U-238						
Gross Alpha						
Gross Beta			X			
GEA			X			

Note: Blocks with double x's means the equipment was used for that isotope separation at B Plant.

Table C-3. PUREX COPC Assessment (Page 1 of 3)

COPC	R-1, Pump	G5-1, Pump	A3, B3, C3, Dissolvers	F-8, Tank	F-7, Tank	Crane Tool Box	Dissolver Shipping Capsule	F-14, Tank
Aluminum (fines)			X					
Aluminum Nitrate Nonahydrate			X					
Ammonium Fluoride/Ammonium Nitrate			X					
Lead								
Nitric Acid			X	X	X			X
Normal Parafin Hydrocarbons (NPH)	X	X		X				X
Polychlorinated Biphenyls (PCBs)	?	?						
Potassium Hydroxide			X					
Potassium Permanganate	X							
Sodium Carbonate	X							
Sodium Hydroxide			X		X			
Sodium Nitrate			X					
Sugar					X			
Tributyl Phosphate	X	X		X				X
Zirconium (fines)			X					
Am-241			X	X	X			X
Co-60		X	X	X	X			X
Cs-134		X	X	X	X			X
Cs-137		X	X	X	X			X
Eu-152		X	X	X	X			X
Eu-154		X	X	X	X			X
Np-237			X	X	X			X
Pu-238			X	X	X			X
Pu-239/240			X	X	X			X
Ra-226			X	X	X			X
Ra-228			X	X	X			X
Sr-90		X	X	X	X			X
Th-228			X	X	X			X
U-234	X		X	X	X			X
U-235	X		X	X	X			X
U-238	X		X	X	X			X
Gross Alpha		X				X	X	
Gross Beta		X				X	X	
GEA		X				X	X	

Table C-3. PUREX COPC Assessment (Page 2 of 3)

COPC	Tube Bundle Shipping Capsule	Condenser Assembly	Dissolver Catch Yoke	F-5, Condenser	G-G3-SO, G-G3, Centrifuges	EA-2, Off-gas Heater	H-4	Condenser
Aluminum (fines)								
Aluminum Nitrate Nonahydrate								
Ammonium Fluoride/Ammonium Nitrate								
Lead								
Nitric Acid		X		X			X	
Normal Parafin Hydrocarbons (NPH)					X			
Polychlorinated Biphenyls (PCBs)					?			
Potassium Hydroxide								
Potassium Permanganate					X			
Sodium Carbonate					X			
Sodium Hydroxide								
Sodium Nitrate								
Sugar								
Tributyl Phosphate					X			
Zirconium (fines)								
Am-241								
Co-60		X		X	X	X	X	X
Cs-134		X		X	X	X	X	X
Cs-137		X		X	X	X	X	X
Eu-152		X		X	X	X	X	X
Eu-154		X		X	X	X	X	X
Np-237		X		X	X	X	X	X
Pu-238		X		X	X	X	X	X
Pu-239/240		X		X	X	X	X	X
Ra-226		X		X	X	X	X	X
Ra-228		X		X	X	X	X	X
Sr-90		X		X	X	X	X	X
Th-228		X		X	X	X	X	X
U-234		X		X	X	X	X	X
U-235		X		X	X	X	X	X
U-238		X		X	X	X	X	X
Gross Alpha		X		X	X	X	X	X
Gross Beta	X		X					
GEA	X		X					

Table C-3. PUREX COPC Assessment (Page 3 of 3)

COPC	G-E2, Centrifuge	PG-G2, Pulser	Off-gas jumper
Aluminum (fines)	X		
Aluminum Nitrate Nonahydrate	X		
Ammonium Fluoride/Ammonium Nitrate	X		
Lead			? (Visual)
Nitric Acid	X	X	
Normal Parafin Hydrocarbons (NPH)			
Polychlorinated Biphenyls (PCBs)	?	?	
Potassium Hydroxide	X		
Potassium Permanganate			
Sodium Carbonate			
Sodium Hydroxide	X		
Sodium Nitrate	X		
Sugar			
Tributyl Phosphate			
Zirconium (fines)	X		
Am-241			
Co-60	X		
Cs-134	X		
Cs-137	X		
Eu-152	X		
Eu-154	X		
Np-237	X		
Pu-238	X		
Pu-239/240	X		
Ra-226	X		
Ra-228	X		
Sr-90	X		
Th-228	X		
U-234	X		
U-235	X		
U-238	X		
Gross Alpha	X		
Gross Beta		X	X
GEA		X	X

Table C-4. REDOX COPC Assessment (Page 1 of 2)

COPC	D-13, Tank	G-3, Tank	G-3, Concentrator	H-4, Coil	11-V-D-12, Pot	D-10, Pot	D-14, Tower	F-1, Pot	F-2, Tower
Aluminum Nitrate Nonahydrate (ANN)	X			X	X	X	X	X	X
Hexone	X	X	X		X	X	X	X	X
Lead									
Nitric Acid	X			X	X	X	X	X	X
Polychlorinated Biphenyls (PCBs									
Potassium Permanganate	X				X	X			
Sodium Carbonate	X				X	X			
Sodium Dichromate	X				X	X			
Sodium Hydroxide	X	X	X	X	X	X		X	X
Sodium Nitrate	X			X	X	X		X	X
Am-241	X	X	X	X	X	X	X	X	X
Co-60	X	X	X	X	X	X	X	X	X
Cs-134	X	X	X	X	X	X	X	X	X
Cs-137	X	X	X	X	X	X	X	X	X
Eu-152	X	X	X	X	X	X	X	X	X
Eu-154	X	X	X	X	X	X	X	X	X
Np-237	X	X	X	X	X	X	X	X	X
Pu-238	X	X	X	X	X	X	X	X	X
Pu-239/240	X	X	X	X	X	X	X	X	X
Ra-226	X	X	X	X	X	X	X	X	X
Ra-228	X	X	X	X	X	X	X	X	X
Sr-90	X	X	X	X	X	X	X	X	X
Th-228	X	X	X	X	X	X	X	X	X
U-234	X	X	X	X	X	X	X	X	X
U-235	X	X	X	X	X	X	X	X	X
U-238	X	X	X	X	X	X	X	X	X
Gross Alpha									
Gross Beta									
GEA									

Table C-4. REDOX COPC Assessment (Page 2 of 2)

COPC	Tube Bundles	Tank	Tube Bundle Capsule	Pot Dissolver	Pot Tower	Pot Dissolver	Centrifuge A-Frame	Silo Leaded Glass Window	F-2, Pot
Aluminum Nitrate Nonahydrate (ANN)				X	X	X			X
Hexone					X				X
Lead								X	
Nitric Acid				X	X	X			X
Polychlorinated Biphenyls (PCBs									
Potassium Permanganate									
Sodium Carbonate									X
Sodium Dichromate									
Sodium Hydroxide				X	X	X			X
Sodium Nitrate				X	X	X			X
Am-241	X	X		X	X	X			X
Co-60	X	X		X	X	X			X
Cs-134	X	X		X	X	X			X
Cs-137	X	X		X	X	X			X
Eu-152	X	X		X	X	X			X
Eu-154	X	X		X	X	X			X
Np-237	X	X		X	X	X			X
Pu-238	X	X		X	X	X			X
Pu-239/240	X	X		X	X	X			X
Ra-226	X	X		X	X	X			X
Ra-228	X	X		X	X	X			X
Sr-90	X	X		X	X	X			X
Th-228	X	X		X	X	X			X
U-234	X	X		X	X	X			X
U-235	X	X		X	X	X			X
U-238	X	X		X	X	X			X
Gross Alpha			X				X	X	
Gross Beta			X				X	X	
GEA			X				X	X	

Table C-5. U Plant COPC Assessment (Page 1 of 5)

COPC	Tank (no identification)	4-8, Tank	5-1, Tank	5-2, Tank	5-6, Tank	Evaporator Dunnage	6-4, Tank	E-8-1, Evaporator	Cell 15, Original Equipment	Pulse Column
Acetylene Tetrabromide										
Asbestos										
Bismuth Phosphate			X	X	X		X	X	X	
Kerosine			X	X	X					
Lead										
Mercury										
Nitric Acid			X	X	X		X	X	X	
Oil/Grease										
Polchlorinated Biphenyls (PCBs)										
Selenium										
Tributyl Phosphate			X	X	X					
Uranyl Nitrate Hexahydrate			X	X	X		X	X	X	
Sodium Chloride			X	X	X		X	X	X	
Sodium Hydroxide			X	X	X		X	X	X	
Sodium Nitrate			X	X	X		X	X	X	
Phorsphoric Acid			X	X	X					
Ferrous Ammonium Sulfate			X	X	X					
Sulfamic Acid			X	X	X					
Am-241			X	X	X					
Co-60			X	X	X					
Cs-134			X	X	X					
Cs-137			X	X	X					
Eu-152			X	X	X					
Eu-154			X	X	X					
Np-237			X	X	X					
Pu-238			X	X	X					
Pu-239/240			X	X	X					
Ra-226			X	X	X					
Ra-228			X	X	X					
Sr-90			X	X	X					
Th-228			X	X	X					
U-234			X	X	X					
U-235			X	X	X					
U-238			X	X	X					
Gross Alpha										
Gross Beta										
GEA										

NOTE: Equipment that does not have COPC's assigned to it would need to be sampled for the full set of chemicals

Table C-5. U Plant COPCs Assessment (Page 2 of 5)

COPC	7-4, Concentration Dunnage	Cell 19, Original Equipment	Cell 24, Tank	11-6-3, Pump	Cell 25, Pumps & Agitators	Cell 32, Tank	9-H(4?), Tank	9-7, Tank	Cell 3[illegible], Tower	20-6, Bathtub
Acetylene Tetrabromide										
Asbestos										
Bismuth Phosphate	X	X	X	X			X	X		
Kerosine		X	X	X		X	X	X		X
Lead										
Mercury										
Nitric Acid	X	X	X	X		X			X	
Oil/Grease		X	X	X						
Polchlorinated Biphenyls (PCBs)		X	X	X						
Selenium										
Tributyl Phosphate		X	X	X		X	X	X		X
Uranyl Nitrate Hexahydrate	X	X	X	X		X	X	X	X	
Sodium Chloride	X	X	X	X		X	X	X	X	
Sodium Hydroxide	X	X	X	X			X	X		
Sodium Nitrate	X	X	X	X			X	X		
Phorsphoric Acid										
Ferrous Ammonium Sulfate		X	X	X			X	X		
Sulfamic Acid										
Am-241										
Co-60										
Cs-134										
Cs-137										
Eu-152										
Eu-154										
Np-237										
Pu-238										
Pu-239/240										
Ra-226										
Ra-228										
Sr-90										
Th-228										
U-234										
U-235										
U-238										
Gross Alpha										
Gross Beta										
GEA										

NOTE: Equipment that does not have COPC's assigned to it would need to be sampled for the full set of chemicals

Table C-5. U Plant COPCs Assessment (Page 3 of 5)

COPC	Cell 13, Condenser	Cell 24, Concentrator Column	Cell 26, Pumps/ agitators	7-1, Fuel Storage Rack	Fuel Canisters	A-11-1, Agitator	2A-24-1-2, Agitator	2A-A6-1, Agitator	P-13-6-1, Pump	P-4-6-2, Pump
Acetylene Tetrabromide										
Asbestos										
Bismuth Phosphate	X					X		X	X	X
Kerosine						X			X	X
Lead										
Mercury										
Nitric Acid	X							X		X
Oil/Grease										
Polchlorinated Biphenyls (PCBs)										
Selenium										
Tributyl Phosphate						X			X	X
Uranyl Nitrate Hexahydrate	X					X		X	X	X
Sodium Chloride	X					X		X	X	X
Sodium Hydroxide	X					X		X	X	X
Sodium Nitrate	X					X		X	X	X
Phorsphoric Acid										X
Ferrous Ammonium Sulfate						X		X	X	X
Sulfamic Acid									X	X
Am-241										
Co-60										
Cs-134										
Cs-137										
Eu-152										
Eu-154										
Np-237										
Pu-238										
Pu-239/240										
Ra-226										
Ra-228										
Sr-90										
Th-228										
U-234										
U-235										
U-238										
Gross Alpha										
Gross Beta				X	X					
GEA				X	X					

NOTE: Equipment that does not have COPC's assigned to it would need to be sampled for the full set of chemicals

Table C-5. U Plant COPCs Assessment (Page 4 of 5)

COPC	P-4-6-1, Pump	P-11-6-3, Pump	P-18-3, Pump	P-10-7, Pump	P-16-6-2, Pump	P-14-7-2, Pump	A-18-3, Agitator	A-14-2, Agitator
Acetylene Tetrabromide								
Asbestos								
Bismuth Phosphate	X	X		X		X		X
Kerosine	X	X	X	X	X		X	
Lead								
Mercury								
Nitric Acid	X				X			X
Oil/Grease								
Polchlorinated Biphenyls (PCBs)								
Selenium								
Tributyl Phosphate	X	X	X	X	X		X	
Uranyl Nitrate Hexahydrate	X	X	X	X	X	X	X	X
Sodium Chloride	X	X		X	X	X		X
Sodium Hydroxide	X	X		X		X		X
Sodium Nitrate	X	X		X		X		X
Phorsphoric Acid	X		X				X	
Ferrous Ammonium Sulfate	X	X		X				
Sulfamic Acid	X						X	
Am-241								
Co-60								
Cs-134								
Cs-137								
Eu-152								
Eu-154								
Np-237								
Pu-238								
Pu-239/240								
Ra-226								
Ra-228								
Sr-90								
Th-228								
U-234								
U-235								
U-238								
Gross Alpha								
Gross Beta								
GEA								

NOTE: Equipment that does not have COPC's assigned to it would need to be sampled for the full set of chemicals

Table C-5. U Plant COPCs Assessment (Page 5 of 5)

COPC	A-17-3, Agitator	T-10-4, Concentrator	Comments
Acetylene Tetrabromide			Not Expected in the Canyon. Expected in Operating Gallery
Asbestos			Not expected on equipment in the canyon/cells.
Bismuth Phosphate		X	
Kerosine	X	X	
Lead			Could be present on Jumpers & equipment in cells.
Mercury			Not expected to be present in equipment.
Nitric Acid			
Oil/Grease			May be present in resevoirs on pumps/agitators.
Polchlorinated Biphenyls (PCBs)			May be present in oil/grease in equipment.
Selenium			Source unknown
Tributyl Phosphate	X	X	
Uranyl Nitrate Hexahydrate	X	X	
Sodium Chloride	X	X	
Sodium Hydroxide		X	
Sodium Nitrate		X	
Phorsphoric Acid			
Ferrous Ammonium Sulfate		X	
Sulfamic Acid			
Am-241			
Co-60			
Cs-134			
Cs-137			
Eu-152			
Eu-154			
Np-237			
Pu-238			
Pu-239/240			
Ra-226			
Ra-228			
Sr-90			
Th-228			
U-234			
U-235			
U-238			
Gross Alpha			
Gross Beta			
GEA			

NOTE: Equipment that does not have COPC's assigned to it would need to be sampled for the full set of chemicals

APPENDIX D

STATISTICAL EVALUATION

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INTRODUCTION

This appendix includes graphical representations and statistical comparisons of general area dose rate data from the canyon deck and the galleries and stairwells. Graphical and statistical evaluations of the two data sets were performed to help determine the degree of contamination in the galleries and stairwells relative to the contamination in the canyon area itself. The conclusions from the comparisons will be used to support the recommendation that no additional isotopic distribution data for radionuclides in the galleries is needed to support a disposition alternative.

Figures D-1 through D-4 show three graphical methods of illustrating a data distribution. These graphs allow a qualitative comparison of the canyon deck data set and the data sets from the other areas for general area dose rate. Observations reported as non-detected values are shown in the figures as half of the detection limit. Below is a general description of the graphics that appear in each figure.

- In the upper left corner—the histogram of the canyon deck data is presented for general area dose rate. The horizontal axis gives the observed readings in uR/hr, while the vertical axis gives the number of observations in each dose reading class.

- In the lower left corner—the histogram of the dose rate detected in other area (specific gallery or stairwell). The axes are the same as for the canyon deck histogram.

- In the upper right corner—box plots of both the canyon deck data and the other area data. The outer box area of these plots identify the region between the 25th and 75th percentiles (also known as the interquartile range); the middle line represents the median. The dashed lines extending out form the box represent 1.5 times the interquartile range, providing an interval outside which data may be evaluated for their potential to be outliers. The vertical axis units are dose rate in uR/hr.

- In the lower right corner—density functions of both the canyon deck data and the other area data. The density functions are smoothed, normalized "histograms" where the horizontal axis units are again dose rate in uR/hr. The solid line represents the canyon deck data; the dotted line represents the other area data. The vertical axis is essentially equivalent to the probability of observing any particular concentration, but because these are continuous distributions, the exact probabilities are actually the areas under the curve within some interval of dose rate.

Distribution shift tests were performed to determine whether the canyon deck data and the other areas' data are statistically different. The distribution shift tests that were performed are sometimes known as the "Gilbert toolbox" tests, and are referenced in Gilbert (1984). The tests are the Gehan/Wilcoxon Rank Sum (Gehan) test, the Quantile test, and the Slippage test. Non-detected values are coded as negative detection limit values for these tests. Each of the test is written to account for non-detected values in their results.

The Gehan test is best suited for assessing complete shifts in distribution, whereas the Quantile test is better suited for assessing partial shifts. The Slippage test determines the probability of the observed number of gallery or stairwell values being greater than the maximum canyon deck value, given that the gallery or stairwell data originates from the same distribution as the canyon deck data. Among the three tests, most types of differences between distributions can be determined.

Observed significance levels (p-values) are reported for the tests. The p-value is the probability of observing data at least a different from the canyon deck data as the gallery or stairwell data; if the gallery or stairwell distribution is the same as the canyon deck distribution. If a p-value is less than 0.05, then there is reason to suspect that there is a difference between the canyon deck and gallery or stairwell distributions; otherwise, no difference is indicated and the gallery or stairwell distribution is not statistically different from the canyon deck distribution.

RESULTS

Table D-1 shows a summary of the data that were used to perform the comparisons. The data originate from Tables 5-4 through 5-10 in Section 5.0 of the text and the data summary sheets found in the DQO Scoping Binder (Rugg 1997). Dose rates that were at or below the detection limit of the instrument are coded as negative values.

Table D-1 shows that the dose rate in the canyon deck is orders of magnitude greater than the dose rate in the other areas. The graphical and statistical comparisons will verify this observation and will help demonstrate that the inventory in the galleries, stairwells, and crane way do not significantly contribute to the overall inventory of the entire structure.

Table D-1. General Area Dose Rates for the Galleries, Stairwells, Crane Way, and Canyon Deck (Page 1 of 3)

Section	Electrical Gallery (uR/hr)	Piping Gallery (uR/hr)	Operating Gallery (uR/hr)	Stairwells (uR/hr)	Canyon Deck (uR/hr)
1	NA	NA	7	6	-500
1	NA	NA	7	NA	6000
2	9	10	9	7	500
2	NA	10	10	7	NA
2	NA	NA	10	NA	NA
2	NA	NA	11	NA	NA
3	9	9	8	7	700
3	10	10	8	7	NA
3	9	9	8	8	NA
4	9	11	7	8	1000

Table D-1. General Area Dose Rates for the Galleries, Stairwells, Crane Way, and Canyon Deck (Page 2 of 3)

Section	Electrical Gallery (uR/hr)	Piping Gallery (uR/hr)	Operating Gallery (uR/hr)	Stairwells (uR/hr)	Canyon Deck (uR/hr)
4	10	11	7	8	NA
4	NA	11	8	8	NA
5	9	20	7	8	90000
5	9	20	7	8	1500
5	9	50	8	8	NA
5	NA	50	NA	8	NA
6	9	10	8	8	84000
6	9	10	8	8	2000
6	10	10	9	8	NA
6	NA	11	NA	8	NA
6	NA	30	NA	-500	NA
7	9	9	8	-500	3500
7	10	9	8	-500	1000
7	10	9	9	-500	NA
8	9	9	9	-500	1000
8	10	10	9	-500	NA
8	11	NA	NA	-500	NA
9	9	9	8	-500	6000
9	10	10	8	-500	1500
9	10	10	8	-500	NA
10	9	9	8	-500	1000
10	9	10	8	6	1000
10	NA	10	NA	6	NA
11	9	9	8	7	1000
11	10	10	8	7	60000
11	10	NA	9	7	6000
12	9	8	8	8	8000
12	9	8	8	8	2000
12	NA	NA	8	NA	NA
13	10	9	8	8	NA
13	10	9	8	8	NA

Table D-1. General Area Dose Rates for the Galleries, Stairwells, Crane Way, and Canyon Deck (Page 3 of 3)

Section	Electrical Gallery (uR/hr)	Piping Gallery (uR/hr)	Operating Gallery (uR/hr)	Stairwells (uR/hr)	Canyon Deck (uR/hr)
13	11	NA	9	7	NA
14	9	8	9	7	5000
14	10	9	9	7	NA
15	NA	NA	9	NA	NA
15	9	9	8	7	NA
15	9	9	8	7	NA
15	10	NA	9	7	NA
16	9	9	8	7	1500
16	10	10	9	7	2000
16	11	NA	NA	7	NA
17	9	9	9	7	3500
17	9	10	9	7	4000
17	NA	NA	NA	10	25000
18	9	9	8	8	4000
18	10	9	9	8	NA
18	11	NA	NA	8	NA
19	9	9	8	8	96000
19	10	10	9	8	NA
19	NA	NA	9	NA	NA
20	10	9	9	8	510000
20	10	10	10	8	NA
20	9	NA	10	8	NA
20	40	NA	NA	8	NA

NA = not available

Figures D-1 through D-4 show graphically the relationships between the canyon deck data and the galleries and stairwell data. The area dose rates from the canyon deck and the other areas differ by orders of magnitude. Therefore, it is reasonable to qualitatively conclude that the dose rate on the canyon deck is greatly elevated over that in the other areas. This conclusion is verified by the quantitative analysis results shown below.

The p-values resulting from the Gilbert toolbox tests which compare the canyon deck data to each of the other galleries and the stairwell are 0.000, indicating a statistically significant difference between the canyon deck and gallery and stairwell distributions. The conclusion is that the canyon deck distribution is significantly elevated above the distributions from the other areas.

Both the graphical and quantitative analyses confirm the initial conclusion that the dose rate attributable to the canyon deck is much greater than the dose rates in the galleries and stairwells connecting the galleries. Additional fixed laboratory data are being collected from the canyon deck, hence, additional fixed laboratory data collected from the galleries and stairwells is not needed to support a disposition decision.

Figure D-1. Histograms, Boxplots, and Density Estimates Comparing the Results from the Canyon Deck and the Electrical Gallery

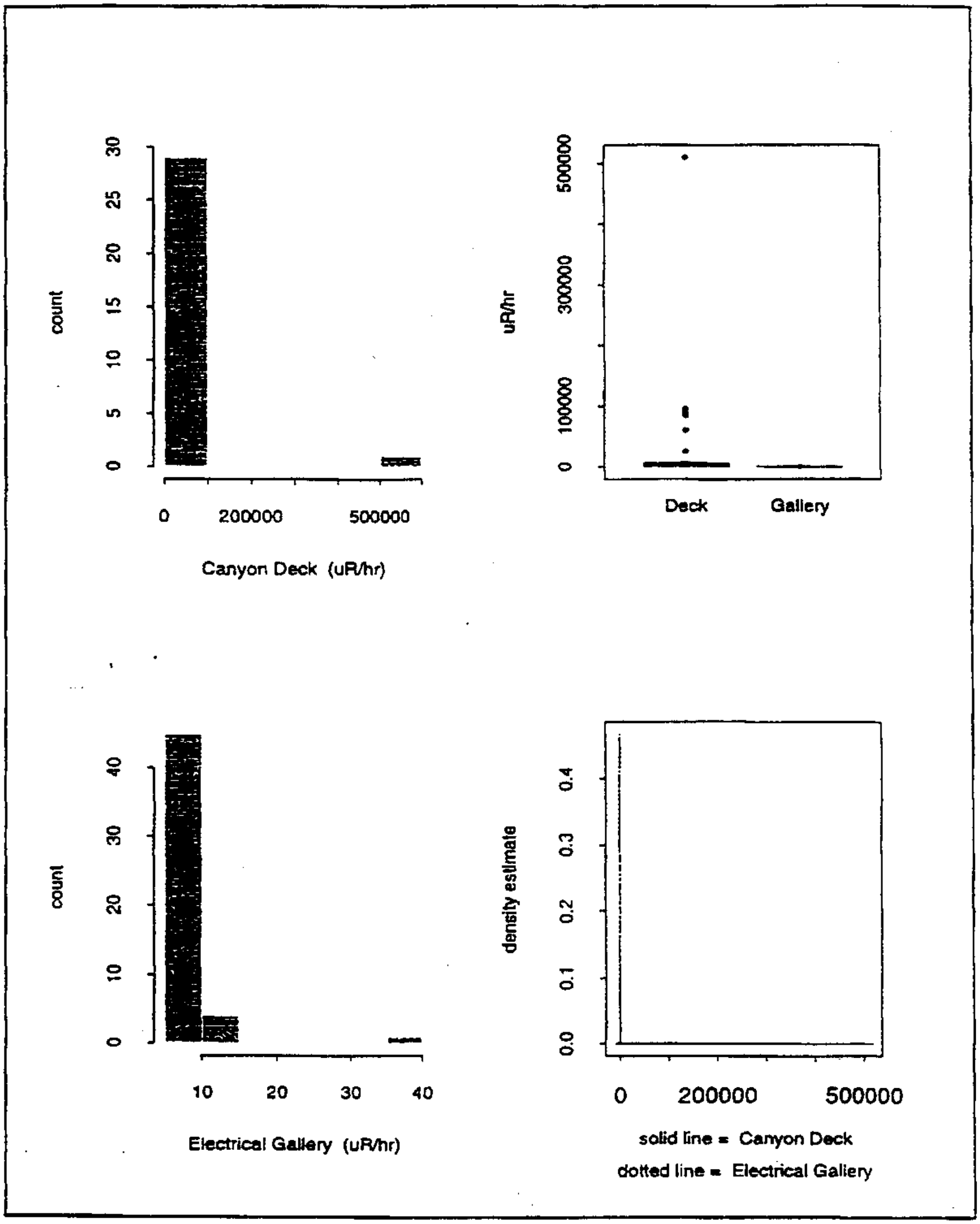


Figure D-2. Histograms, Boxplots, and Density Estimates Comparing the Results from the Canyon Deck and the Piping Gallery

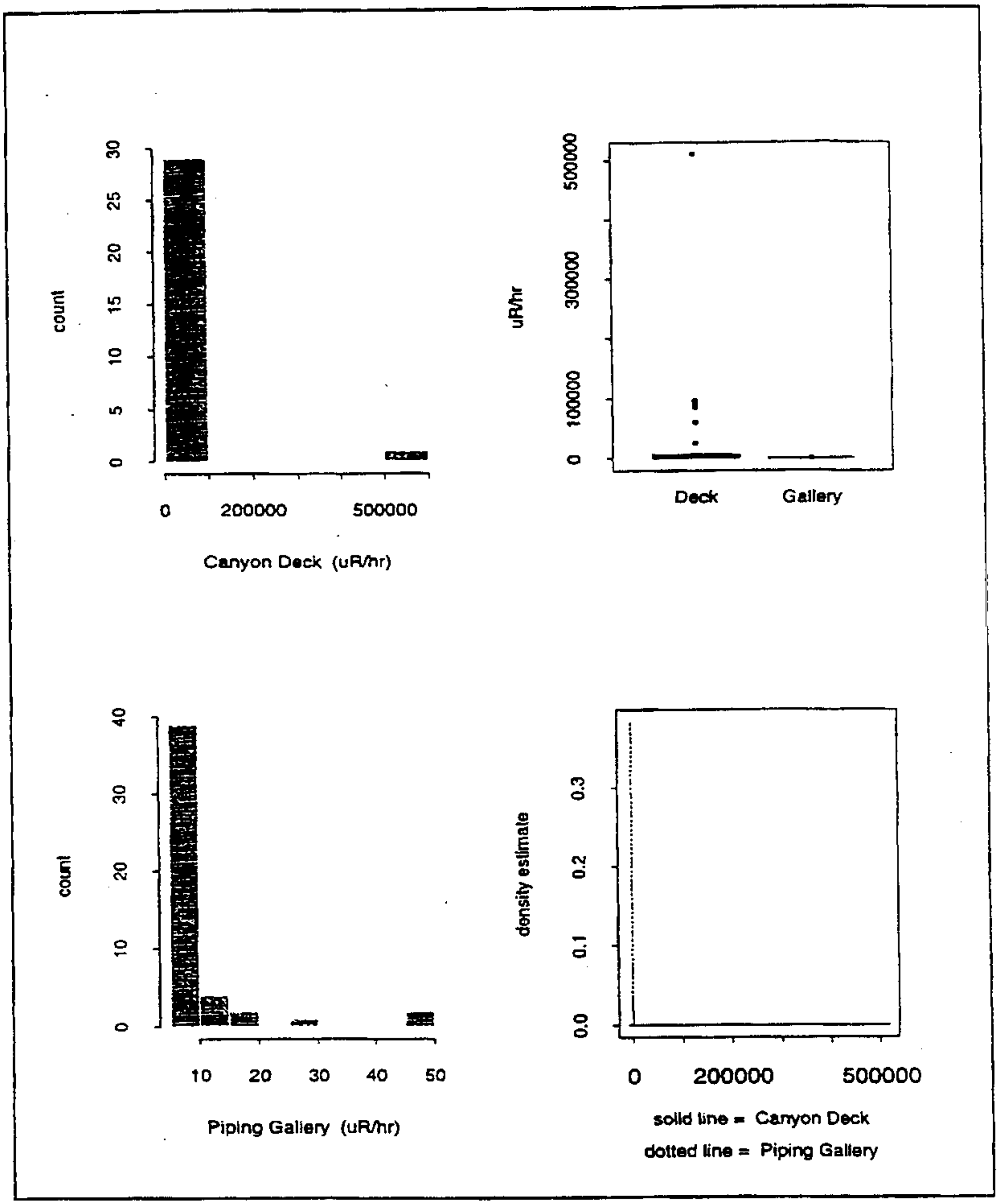


Figure D-3. Histograms, Boxplots, and Density Estimates Comparing the Results from the Canyon Deck and the Operating Gallery

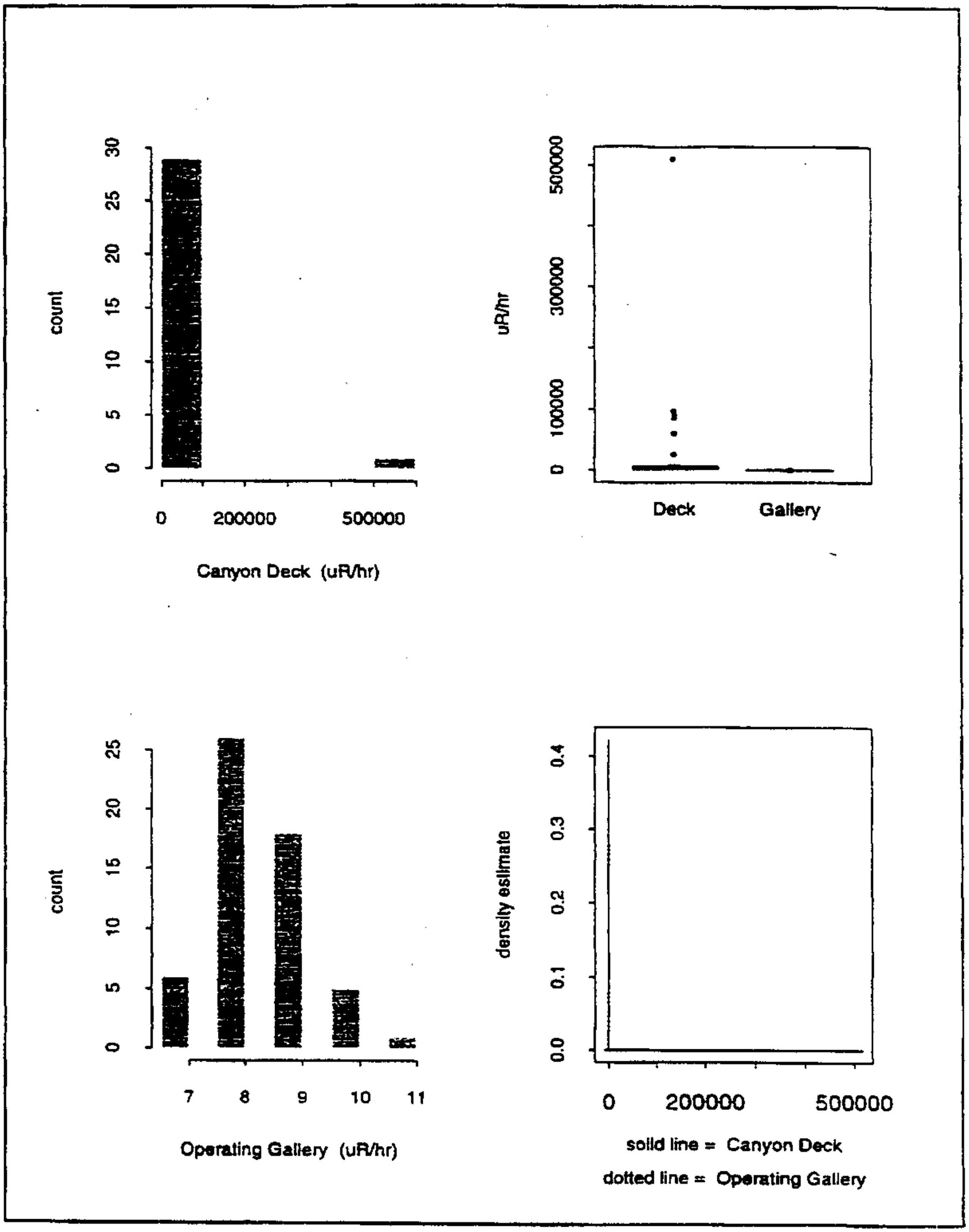
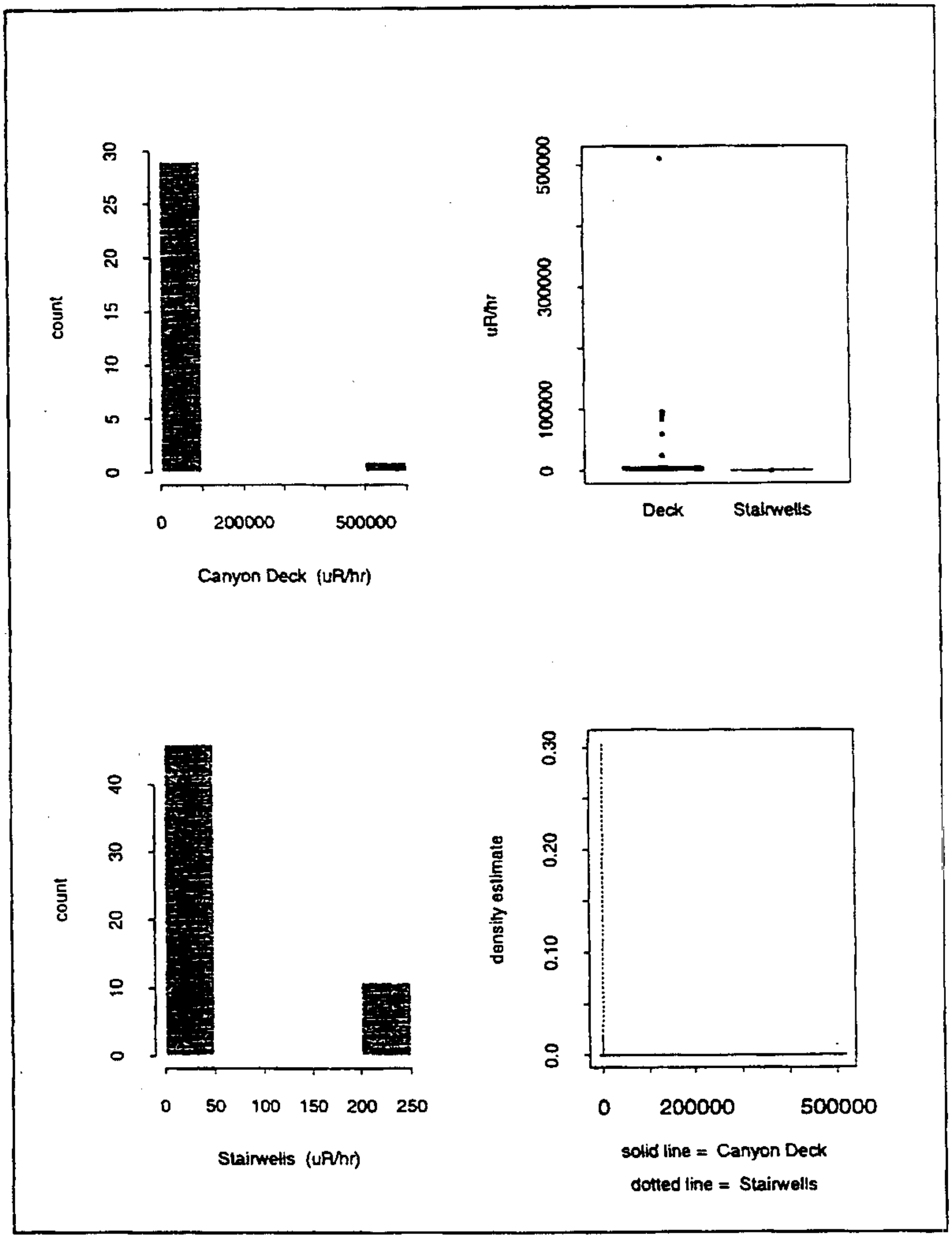


Figure D-4. Histograms, Boxplots, and Density Estimates Comparing Results from the Canyon Deck and the Stairwells Connecting the Galleries



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